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2020 EUROPEAN AGRICULTURE: CHALLENGES & POLICIES

Edited by Pierre H. Boulanger and Patrick A. Messerlin

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Cover painting: "Wheat Field with Sheaves," 1888, Vincent Van Gogh.

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Long-Term Challenges Facing European Agriculture: The Need For New Public And Private Policies

Pierre H. Boulanger and Patrick A. Messerlin[1]

Introduction

In 1957, the Treaty of Rome assigned five goals to the Common Agricultural Policy (CAP): (i) to increase productivity, (ii) to ensure a fair standard of living for farmers, (iii) to stabilize markets, (iv) to assure the availability of supplies, and (v) to ensure reasonable prices for consumers. These goals were relatively uncontentious at that time.

But issues surrounding CAP have become significantly more complex. Climate change, water, and energy have joined challenges that emerged during the 1990s, such as food safety and quality. Some of these are largely the effects of human activity, for example, adjustments to changes in previous policies. Others, such as natural resource management, are imposed and/or magnified by humans, like resource misallocation or waste.

Many challenges require the use of a much broader range of policies than in the past, and private as well as public sector involvement. This observation follows the lesson taken from enforcing the Treaty of Rome: the use of one policy, guaranteed production prices, to achieve the five goals of the Treaty largely explains the total or partial failure to achieve the last four CAP objectives.

This overview presents the eight papers presented at the Conference on 2020 European Agriculture. Two main conclusions emerge from these papers. First, one constant in all debates over long term challenges, including climate change, water, and energy is that more international trade is essential for an increase in the global resilience of agriculture. Second, better targeting of public and private policies is critical—including public policies with a budgetary dimension, such as much larger and better designed subsidies for agricultural-sector research and development.

Long-term challenges: Climate change, water, and energy

The time horizon of these three intertwined challenges is quite different. Problems related to climate change will develop over the coming century. Those related to water are increasingly pressing and energy issues already show how difficult the decision-making process is, and in the case of biofuels, how costly incorrect decisions can be.

Nelson's paper, "Agriculture and climate change", presents the complex "machinery" of the models generated by the work of the Intergovernmental Panel on Climate Change (IPCC). These models try to simulate the interactions between the physics and chemistry of the atmosphere, oceans and land surface, and those between humans and their activities, of which agriculture is only one.

Nelson draws four common conclusions from the six models. First, the world appears to be able to continue to feed the increasing human population during the 21st century despite climate change. Second, it is very likely that there will be substantial differences between regions, with some benefitting and others adversely affected. Third, developing countries, especially the poorest ones, are the most likely to face negative effects. Last but not least, an important means of adapting to these challenges is to facilitate trade among countries and/or regions, a result that may surprise many decision-makers, but one that has been confirmed by a recent French report (INRA and CIRAD 2009).

These results have significant policy implications. First, they require creating more open trade in agriculture: cuts in tariffs and subsidies gain

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a new "raison d'être" as a tool for combating climate-driven hunger. Second, freer trade must be combined with a wide range of pro-active policies, such as (i) taxes or cap-and-trade regimes that reveal the damaging effects of climate change-inducing emissions, (ii) pro-poor and pro-development policies capable of helping the world's poor who perhaps face the most severe impact of climate change, and (iii) a wide range of investment policies in agricultural and rural infrastructure and research-development in order to mitigate and adapt to the effects of climate change.

Schultz's paper, "Agriculture and water", focuses on water availability, a problem expected to become increasingly critical in many countries. Water is a 'local' good, and the fact that water resources are unevenly distributed yet expected to be globally sufficient to support a population of nine billion people is only a part of the problem.

Agriculture is the primary consumer of water, with irrigated agriculture currently accounting for 70 percent of world water withdrawals. Any solution to the water problem thus requires serious improvements in agricultural water use, both in terms of irrigation efficiency and rainwater management. Roughly 45 percent of today's world food production uses 1.1 billion hectares without any water management system (hence with low yields) in comparison with 40 percent on 0.3 billion hectares of irrigated land and up to 15 percent on 0.1 billion hectares equipped with a drainage system. All of these problems are complicated because they should also address water quality and sustainability. Schultz describes the many water management policies that are urgently needed, from increased storage to basin-wide planning, water system modernisation to stakeholder control, at local or national levels. A key ingredient to these measures is a better pricing regime for water, and therefore an enhanced definition of water property rights.

Le Vernoy's comments in "Agriculture and virtual water" add a critical aspect that would remove pressures on water policies. If water is a 'local good', then intra- or inter-national agricultural trade can link local water resources and their associated farm productions to widely-dispersed food consumptions. This approach is captured by the notion of "virtual" water, that is, the volume of water required to produce a given commodity. As the specific water requirement for a crop varies significantly in space and time from one country to another, trade of farm and food products represents virtual water flows between water-rich and water-poor countries, and between water-efficient and water-inefficient countries.

Levi's paper, "Agriculture and energy", focuses on biofuels—a highly developed issue. Fossil fuels have been the backbone of growth during the last two centuries, but they are expected to become increasingly rare within the next fifty years and there is a range of competing successors. Should agriculture contribute to solving this problem by developing biofuels? In this respect, the ethanol and biodiesel first-generation biofuels experience deserves a cost-benefit analysis.

Levi begins by examining the three key rationales for introducing biofuels. First, energy security has historically been the leading feature of biofuel promotion. However, fears of oil and gas supply cut-offs do not represent a sound rationale for promoting biofuels for at least two reasons: There are many alternative measures, from diversification of supply to increased efficiency in the use of fossil fuels. Moreover, current biofuel technologies consume large amounts of natural gas through the production of fertilizers and in processing feedstock into fuel, hence exacerbating security problems rather than alleviating them, especially in gas-dependent regions such as Europe.

Second, biofuels could be a solution to mitigate climate change. The net impact of biofuels is difficult to assess. Under fixed land-use, emissions of greenhouse gases resulting from biofuels are generally lower than those from the gasoline or conventional diesel they displace. However, from the energy crop planting to the consequent-biofuel burning, this first impact is only significant for sugarcane-based ethanol; it is very marginal for corn-based ethanol. More importantly, biofuels replace previous food production and hence generate land use changes, with pastures and forestries being transformed into crop fields. Such an indirect effect tends to be very negative, in some cases reversing decades of the positive effects (if one assumes fixed land use).

Third, biofuels have the potential to drive up global food prices, as best illustrated by the food price surges in 2007–2008. Substantial increases of food and energy prices were largely triggered by shifting land traditionally devoted to food production to the production of first-generation biofuels.

These observations raise two questions. First, could one expect better results with second-generation biofuels, mostly based on crop residues (such as cornhusks) and woody biomass (such as wood chips)? Such biofuels are projected to have a lower impact on agricultural land. But it remains to be seen whether they will fulfil their promise as none are currently produced commercially.

Second, what role should governments play in the biofuel sector? The most important conclusion in this respect is what they should not do. Governments should stop the large-scale support of both production and consumption of first generation biofuels, as well as public incentives for hazardous land use conversions. Beyond this urgent action, the main pro-active public policy in biofuel matters would consist of support for research and development investments in second generation biofuels, reinforcing a recommendation already underlined by climate change policies.

Agriculture and new public policies

The coming years will see the development of three types of public policies which were largely marginal during previous decades: those dealing with food safety and security, those targeting structural adjustment and those ensuring agricultural and rural areas' "multi-functionality."

These policies deal with concerns that often nurture fears and protectionism. It is worth recalling that the European diet, an essential component of health, has little in common with typical diets thirty or forty years ago, and this is mainly due to international trade of food and farm products. That said, in a rapidly globalizing world, a key question raised by these three policies is to know how to develop them while limiting distortions on production and trade.

Swinnen's paper on "Agriculture and food security, safety and quality" focuses on recent concerns, reflecting the top rank of safety and quality issues in European preferences. The traditional focal points of agricultural policies, food security or adequate quantitative supply of agricultural products, are becoming less important in European agricultural policy, although they are still present among the main policy objectives. European Community (EC) expenditures are still dominated by market and income support. What can therefore be said to be the optimal policy mix with regard to food security, food safety and food quality?

Food security is largely a demand problem, not a supply problem. This observation has two consequences. First, the EC should address food insecurity by ensuring a sufficient level of income for its poorest consumers (similarly, in developing countries, poverty reduction would also ensure food security, especially for households

located in rural areas). Such an approach suggests a public policy shift, away from farm income support towards the issues of risk and uncertainty related to agricultural markets. Second, if upward pressures on farm and food prices would induce an increase in world production, lagging productivity growth rates in Europe (and elsewhere) make investment in research and development critical for an improvement in the productivity of farm production, while reducing the pressures of biofuels on farm and food prices. In this context, the EC should consider to reallocate a substantial share of the CAP budget for encouraging green technologies and stimulating the "rural/food/bio" economy.

Food safety policy has been a Member States' competence until the early 2000s, except for veterinary rules. It is based on an integrated 'from farm to fork' approach focusing on tractability, controlling risks in all the stages of farm and food production and distribution. The EC has also adopted many specific sector regulations, from pesticide use to packaging restrictions. Since such regulations have been designed and implemented recently, it is essential to evaluate whether they are efficient enough in addressing public concerns related to food safety, and whether they need to be adjusted in the perspective of the coming CAP reform, trade agreements and trade developments.

Quality policy is not institutionalized at the European level, though it benefits from support granted under the CAP Pillar II, with some of the programs being explicitly linked to upgrading or producing quality. Most of the policy initiatives are recent and enforced at the Member State level. Governments are presently getting involved in the quality schemes and are setting up public–private partnerships, unlike the recent past when quality was only a private-sector initiative. Whether there is a need for a European layer for the food quality system remains a key policy issue for the future.

Swinnen's paper highlights a crucial point as to what extent European food safety and quality policies are barriers or catalysts to trade. Not only can almost any standard cause trade distortions, but there are also critical dynamics between public and private standards, the latter usually being more restrictive than the former. Hence, two key questions need to be raised. First, is there a need to make some adjustments in regards to public standards in light of rapidly growing private standards? Second, how could or should these standards be dealt with at regional and multilateral levels?

Moreddu's paper on "Agriculture and structural adjustment" begins by noting that structural adjustment reflects changes in resource allocation in a moving economic environment, leading to the consolidation and diversification of farm holdings. The paper stresses farmers' intrinsic ability to adapt, a feature often underestimated by governments and sometimes slowed down by public regulations and existing institutions.

Moreddu identifies the economic motivations behind public intervention in adjustment matters. First, authorities may want to facilitate ongoing adjustment for reasons of economic efficiency, such as in case of market failures, or when adjustment costs exceed short-term benefits. Second, public actions can be triggered by equity concerns, for example minimizing losers' losses or limiting increases in income differences. Most EC adjustment measures pertain to CAP's Pillar II Axis 1, which targets the competitiveness of the agricultural sector.

Moreddu's text pays special attention to the importance of ex ante evaluations of adjustment problems. Lessons drawn from recent experience among OECD countries suggest three specific recommendations about adjustment policies. First, government should let farmers develop their own

capacity for adjustment. Second, public support for adjustment should be irreversible and time-limited, unlike current Pillar I direct payments. Third, they should be consistent and integrated into the existing system. These recommendations complement the general principles of optimal agricultural policies: (i) identifying goals in a transparent way, assessing costs and benefits, winners and losers, (ii) decoupling between support and production, (iii) adapting level of efforts to expected results, and (iv) flexibility and equity.

Harvey's paper on "Agriculture and multi-functionality" examines the concept often used to justify continued support to farm production, namely market failures in the presence of externalities and public goods. It underlines the following crucial problem: Governments rarely address the origins of such failures, such as ill-defined property rights, and excessive transaction costs. Thus, policies tend to be inefficient and ineffective in solving the farm multi-functionality puzzle which is in a state of continuous flux and dominated by local considerations, individual preferences and future aspirations on both demand and supply sides. In such a context, the provision of multi-functional services through the current Single Farm Payment scheme is doomed to be a delusion.

This analysis leads to two decisive recommendations regarding the evolution of the most expensive CAP instrument. First, the Single Farm Payment scheme should be phased out because it is unable to provide the appropriate amount of conservation, amenity, recreation and environmental (CARE) goods and services. Second, EC Member States should define, design, implement and fund their own CARE programs—and they should do so in the most decentralized way possible, if they want the origins of the failures to be addressed.

To conclude, Harvey defines the three tasks that the EC should be confined to. First, it should regulate competition between Member States in order to ensure a level playing field within the European market. Second, it should promote economic development and cohesion between regions. Third, it should encourage research and development, and expand the potential of European agricultural and rural lands as multi-productive resources.

Agriculture and new private policies

The last decade has seen greater importance placed upon private policies capable of addressing a wide range of issues in a more appropriate manner than public policies. The management of increasing risks and the emergence of more complex farm and food market structures are among issues that have gained prominence.

Molander's paper on "Agriculture and risk management" begins with an overview of the main risks faced by farm business, namely, risks generated by climatic events, sanitary calamities, price fluctuations and public regulation, risks related to labor force, farm assets and financial markets. Not all of these are agriculture-specific. A key point is that there is no evidence that risks in agriculture are specific enough to receive exclusive treatment, or more precisely, to require more public intervention. In the same vein, are the effects of climatic instability, capital intensity and externalities more important in agriculture than in other economic activities?

Independently from these considerations, what matters is risk management per se; the benefits expected from the use of already well-developed instruments in other sectors. Molander focuses on a set of instruments that are increasingly drawing farmers' attention, from insurance schemes to various types of forward contracts, illustrating the relevance of such private law instruments

in most circumstances. By the same token, he strongly suggests limiting public intervention to "catastrophic" occurrences, when usual statistical techniques on which private risk management is based cannot cope with the magnitude of events.

These observations suggest that the role of public intervention in risk management is rather limited. Nevertheless, Molander's paper underlines the role of public authorities in ensuring transparency and a level playing field in the European market, a point echoed by the next paper.

Spector's paper on "Agriculture, agribusiness and competition policy" begins by underlining prevailing tensions between CAP and competition policy, the two most integrated European policies. CAP was mostly based on "common market organizations" (CMOs) with commodity-price fixing, production quotas in some instances, production and export subsidies, and severe barriers to entry in the sector, such as access to land. All of these instruments are generally prohibited by competition policy.

However, since the early 2000s, successive CAP reforms have notably reduced CAP abnormality with respect to basic competition principles. The most significant changes have seen most CMOs dismantled, the elimination of quotas (or planned elimination) and declines in highly distorting subsidies. However, national or regional decoupling modalities of direct payments may impede competition between member states.

That said, Spector's paper explains how competition policy has also evolved, allowing it to take into account certain specificities of the agricultural sector. This point is crucial as, contrary to a popular belief, the agricultural sector is within the reach of competition policy, as illustrated by decisions taken by the competition authorities, such as a 2003 competition case in which the Commission prohibited minimum purchase prices for some categories of beef in France.

The specific arguments that competition policy could take into account are not those mentioned in favor of production subsidies or import restrictions, rather, they are those related to market structures. For instance, competition authorities may recognize the legitimacy of market organizations, as long as the limited restrictions to competition imposed by such organizations are aimed at solving clearly identified market failures and are unlikely to harm consumers' interests. Another domain where competition authorities may look favorably at the farmers' stance is the critical relations between farmers and distributors, particularly large retailers. Again, competition authorities will not intervene systematically in favor of one of the two sides. Rather, they will try to ensure that distributors' market power will not be excessive, to prevent the imposition of prices so low that farmers will be induced to decrease production, or to innovate less. In short, the tensions between CAP and competition policy may still be systematic on certain points, but the competition authorities' "rule of reason" approach opens a degree of convergence with farm policy that is increasingly based on farmers operating in more competitive markets.

A final remark: European agriculture and budget in 2020

Despite their wide coverage of issues, the eight papers provide an extraordinarily convergent view on farm and food policies to be followed in the next decades: a much wider set of instruments, each of them targeting a very specific issue, ranging from fundamental public policies, such as a better definition of property rights on water, to detailed private measures such as insurance schemes for natural disasters. Table 1 visualizes the

main changes in policies suggested by the various authors.

To what extent will the European budget reflect these profound changes? Answering this question raises the issue of the political legitimacy of CAP. Clearly, the legitimacy of key current instruments, such as the Single Farm Payment, is rapidly declining. European tax-payers are likely to grow more reluctant to pay subsidies to large farmers that are based on increasingly faraway productions and yields; it remains to be seen whether such an evolution includes small farmers.

Similarly, the political legitimacy of subsidies to farmers for the provision of environmental services is unclear. European public opinion surveys imply mixed feelings on whether such subsidies should be granted to farmers who have so often polluted the environment during the past half century. Agriculture is an uneasy exception to the principle that the polluter should pay.

For all these reasons, it seems likely and indeed desirable that the post-2013 CAP budget will be subjected to deep, but progressive cuts. Such cuts

Table 1. Declining policies and emerging policies

	Declining policies			**Emerging policies**						
Topic *Author*	Market-related subsidies	Income support	Regulations	Targeted support	R&D investments	Insurance	Regulations evaluation	Public-private	Competition policy	Open trade
Climate change *Nelson*					xxx	xx				x
Water *Schultz and Le Vernoy*	xxx				xxx	xx		x		x
Energy *Levi*	xxx				xx					x
Food security *Swinnen*	xxx	xxx			xxx			xx		x
Food safety *Swinnen*			x				x			x
Quality *Swinnen*			x				x	x	x	x
Structural adjustment *Moreddu*	xxx	xxx		xx				x	x	x
Multi-functionality *Harvey*	xxx	xxx	x				x	x	x	x
Risk management *Molander*	xxx	xxx				xx				x
Competition policy *Spector*									x	

Note: Policies may have a strong (XXX) moderate (XX) or small (no mark) EC budgetary component.

should also be much greater for Pillar I than for Pillar II.

However, stopping here would be a serious mistake. A common theme of the reviewed papers is the huge need for investment, in particular for research and development related to areas such as new seeds, crops and production processes. As a result, European farmers should join industrialists in asking for a massive shift of the post-2013 European budget to research and development investments, a more accurate term than subsidies. They will benefit from such funds via increased productivity, lower costs, more diversified inputs and products. (Arrow et al. 2008)

Such a dramatic shift deserves two final remarks. First, designing research and development investments (subsidies) is not straightforward. Arrow and alii 2008, provide a non-exhaustive list of key criteria to be respected for such subsidies: (i) stable commitments over a long period of time; (ii) a wide coverage, including the fundamental capacity to perform research in the future (for example, education and laboratory capacities); (iii) tolerance of failures that could provide valuable information and (iv) institutions (such as independent agencies, peer reviews, multi-year appropriations, payments based on progress and outputs rather than cost recovery) that minimize the risk of capture of research and development subsidies by public or private vested interests. It is rather concerning that EC Research and Development Policy meets these criteria rarely, if at all.

Second, European funds should also be devoted to stimulate research and development appropriate for countries poorer than Europe. This perspective could be seen as selfish to the extent that it may indirectly favor European farmers investing in land outside the EC, as they do already. However, such funds are by far the best policy that the EC could offer to repair the serious damage that the "old" CAP has inflicted upon the farm and food sectors of developing countries over the last fifty years.

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Agriculture and Climate Change

Gerald C. Nelson[1]

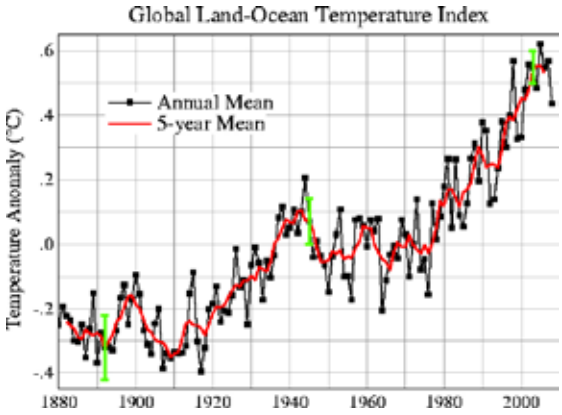
Introduction

Unchecked climate change eventually will have dramatic effects on agricultural production, consumption and trade. The nature of these changes and the extent of their negative effects on human wellbeing remains clouded by uncertainties, in the climate models themselves, the success of our efforts to control greenhouse gas emissions and our collective ability to facilitate adaptation to change. This paper highlights potential changes and associated issues for agricultural science, markets and domestic and international policy. It discusses the adaptation options potentially available to agricultural producers and the role(s) that agriculture could play in mitigating its own, significant contributions to climate change as well as contributing to mitigation of greenhouse gasses (GHGs) emitted from other sectors of the economy.

Climate change and agriculture: What do we know about the effects?

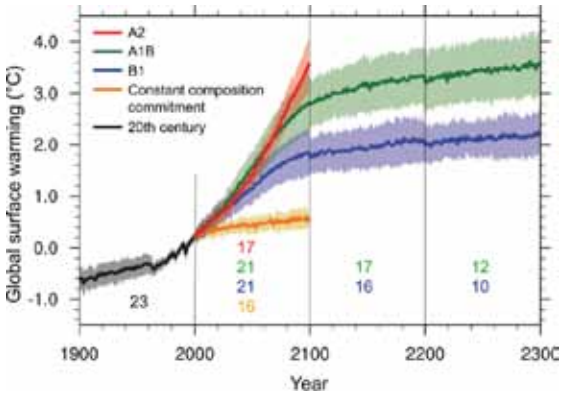
The earth's climate is changing because anthropogenic emissions of greenhouse gasses have been growing rapidly since the industrial revolution. These gasses trap solar radiation that would otherwise be reflected into space, raising the earth's temperature. Figure 1 shows the now-familiar graph of increases in average global temperature from 1880 to 2008 and an especially rapid increase in the last 20 years of the twentieth century. Figure 2 displays simulations of possible future temperature ranges, depending on the extent to which GHG emissions are controlled. Most of the scenarios show temperature increases by the end of the 21st century that dwarf those of the twentieth century.

Figure 1: Global Land-Ocean Temperature Index, 1880–2008 with 1951–1980 as baseline.



Source: http://data.giss.nasa.gov/gistemp/graphs/, Accessed January 14, 2009.

Figure 2: Multi-model means of surface warming relative to 1980–1999.



Source: Figure 10.4 in Meehl, et al. (2007).

The increased energy in the atmosphere manifests itself in higher average temperatures, more evapo-transpiration and hence more overall rainfall but with changes in atmospheric circulation patterns so that the distribution of rainfall over the surface of the earth will change, both in space and in time. Without reductions in GHG emissions growth, the average global temperature will continue to

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increase, as Figure 2 shows, with the rate and magnitude dependent on quantity and timing of these emissions. Extreme events such as the melting of the Greenland ice cap or changes to thermohaline circulation (the Gulf Stream across the Atlantic and its counterparts in other parts of the world's oceans) would exacerbate the effects from temperature and rainfall alone.

Temperature increases, changes in precipitation location, intensity and timing all affect agriculture, with the effects varying significantly by region. However, significant uncertainty remains in how these effects play out over the surface of the earth. To understand the uncertainty it is useful to describe briefly the process by which the results depicted in Figure 2 are derived. They start with global (or general) circulation models (GCMs) that model the physics and chemistry of the atmosphere and its interactions with oceans and the land surface. Several GCMs have been developed independently around the world. Next, integrated assessment models (IAMs) simulate the interactions between humans and their surroundings, including industrial activities, transportation, agriculture and other land uses and estimate the emissions of the various greenhouse gasses (carbon dioxide, methane and nitrous oxide are the most important). Several independent IAMs exist as well. The emissions simulation results of the IAMs are made available to the GCM models as inputs that alter atmospheric chemistry. The end result is a set of estimates of precipitation and temperature values around the globe often at 2 degree intervals (about 200 km at the equator) for most models (see Table 8.1 in Randall, et al. (2007) for details about the models used in the 4th IPCC assessment). Periodically, the Intergovernmental Panel on Climate Change (IPCC) issues assessment reports on the state of our understanding of climate science and interactions with the oceans, land and human activities. The fourth assessment reports (AR4) were issued during 2007 and work has begun on AR5.

Figure 3: 2080–2099 Temperature and Precipitation Changes, Hadley Model and A1B Scenario

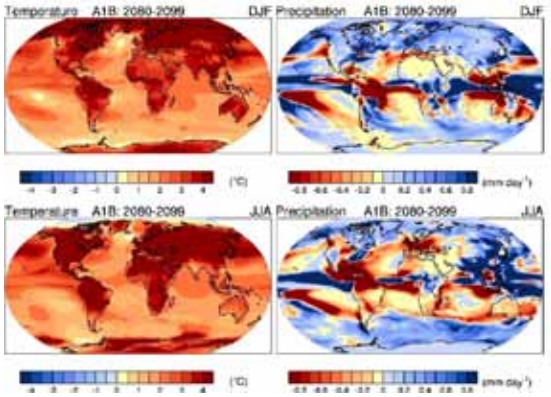
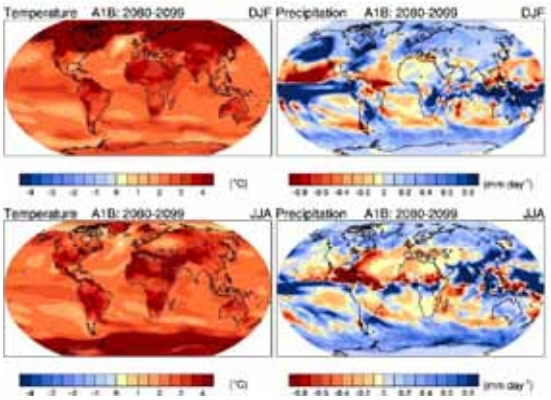


Figure 4: 2080–2099 Temperature and Precipitation Changes, GCM3.1 (T63) Model and A1B Scenario

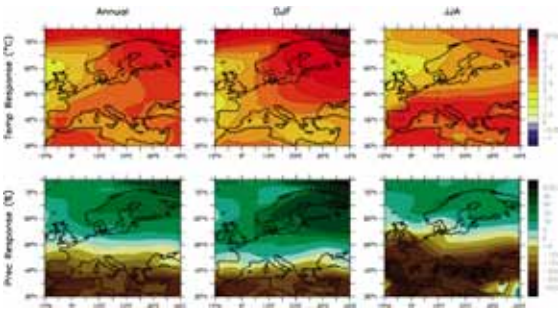


Source: http://ipcc-wg1.ucar.edu/wg1/Report/suppl/Ch10/Ch10_indiv-maps.html, accessed January 16, 2009.

Figure 3 and Figure 4 show temperature and precipitation results from AR4 for the 2080–2099 period for the A1B scenario from two widely reported models—the British Hadley Model and the Canadian Third Generation Coupled Global Climate Model. The top row of figures is for the three month period December to February; the bottom row is June to August. There are two main points to take away from these figures. First there

is broad agreement across the models, both in terms of magnitude of temperature increases and the spatial pattern. For example, the high latitudes, both north and south, will see the largest increases in temperature and large stretches of Africa will get drier. Second, the models exhibit significant differences in some locations and seasons. For example, the Hadley model generally has higher temperatures in Africa in the June–August period than does the GCM3 model.

Figure 5: Europe 2080–2099 Temperature and Precipitation Changes with the A1B Scenario

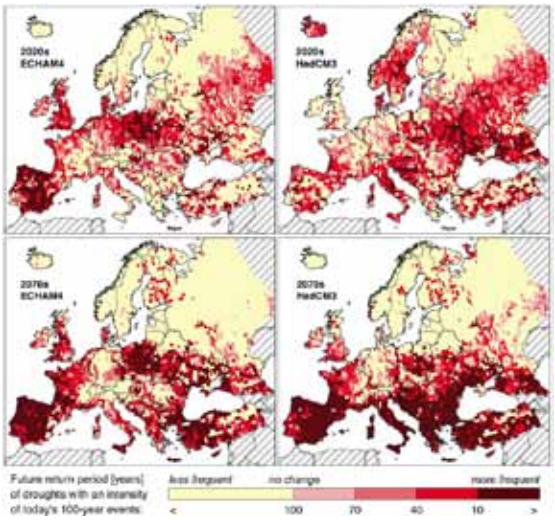


Source: Figure 11.5 in Meehl et al (2007) .

Figure 5 provides a closer look at Europe for the A1B scenario using the combined results from a suite of climate models. According to Meehl et al (2007), "The warming in northern Europe is likely to be largest in winter and that in the Mediterranean area largest in summer (pages 873–874)."

Figure 6 shows the potential for increased occurrences of 100-year droughts in the 2020s and the 2070s in Europe. Again the results differ in details for the different models but southern Europe is likely to see substantial increases in 100 year drought events in both periods and in the early period in central Europe.

Figure 6: Europe 2080–2099 Temperature and Precipitation Changes with the A1B Scenario



Source: Figure 3.6 in Kundzewicz, Mata et al. (2007). Change in the recurrence of 100-year droughts, based on comparisons between climate and water use in 1961 to 1990 and simulations for the 2020s and 2070s (based on the ECHAM4 and HadCM3 GCMs, the IS92a emissions scenario and a business-as-usual water-use scenario). Values calculated with the model WaterGAP 2.1 (Lehner, Döll et al. 2005).

Climate change, agriculture and world markets

Research on the effects of climate change on world agricultural markets is still relatively limited. Crop and animal production are affected both by changes in temperature and precipitation. Agricultural trade flows depend on the interaction between inherent comparative advantage in agriculture, which is determined in part by climate, and a wide-ranging set of local, regional, national and international trade policies. Uncertainties in where climate changes will take place mean lack of clarity about the effects on agricultural production. These uncertainties combine with the complexity of the agricultural policy environment to make simulations fraught with peril. Nonetheless, some researchers have attempted to do so.

Papers in 1992 (Tobey, Reilly et al. 1992) and 1994 (Reilly, Hohmann et al. 1994) concluded that

agricultural impacts of climate change would in some cases be positive and would be manageable globally. Global warming would not seriously disrupt world agricultural markets. Negative yield effects in temperate grain producing regions would be buffered by interregional adjustments in production and consumption. A key assumption was that part of the production losses from temperature and rainfall would be offset by CO_2 fertilization. Another key assumption was that continued liberalization of agricultural trade flows would lead to an agricultural system more resilient in the face of uncertain effects of climate.

A widely cited 2004 publication (Parry, Rosenzweig et al. 2004) based on more complex modeling of both climate and agriculture using the AR3 results was still relatively sanguine about global food production but with more caveats than the earlier papers. "…the combined model and scenario experiments demonstrate that the world, for the most part, appears to be able to continue to feed itself under the SRES scenarios during the rest of this century. The explanation for this is that production in the developed countries generally benefits from climate change, compensating for declines projected for developing nations. While global production appears stable, regional differences in crop production are likely to grow stronger through time, leading to a significant polarisation of effects, with substantial increases in risk of hunger amongst the poorer nations, especially under scenarios of greater inequality (A1FI and A2) (page 66)." These results are strongly influenced by the assumed CO_2 fertilization effect of over 10 percent for wheat, rice and soybeans and five percent for maize. Without CO_2 fertilization, the prognosis is not nearly so bright.

A 2007 study (Reilly, Paltsev et al. 2007) that simulates agricultural response to climate change and incorporates general equilibrium economic effects finds that yields would likely increase in all regions, with smaller gains in the temperate regions than previous models but positive yields in the tropics. As with the earlier studies, their results are strongly affected by the CO_2 fertilization effect. In addition, they make fairly strong assumptions about crop biological behavior in response to climate and other changes.

Two important question marks stand out when evaluating these studies. First, the benefits of CO_2 fertilization are extremely important in essentially mitigating the rainfall and temperature effects of climate change. However, a recent report on field experiments on CO_2 fertilization (Long, Ainsworth et al. 2006), finds that the effects in the field are approximately 50 percent less than in experiments in enclosed containers. And another report (Zavala, Casteel et al. 2008) finds that higher levels of atmospheric CO_2 increase the susceptibility of soybean plants to the Japanese beetle and maize to the western corn rootworm. So the actual, field benefits of CO_2 fertilization remain uncertain. Second, these results all depend on an increasingly open world trading system, where climate-induced shortfalls in some regions can be offset by imports from others. The recent failure of the Doha Round suggests skepticism on whether such trade flows would actually take place. And even if the trading environment becomes as open as assumed in the modeling exercises, there remains the question of whether climate-induced declines in agricultural production and exports in some regions can be offset by increases in production and exports of other products in other regions.

Finally, the recent history of agricultural trade is driven by the rapid growth in production and export of high-value agricultural crops from the developing world, often produced in niche agroclimatic zones. Essentially no research has been done on the extent to which those products would be affected negatively or positively by climate change.

Agricultural adaptation to climate change

Even with the best efforts of world climate negotiators it seems unlikely that we will be able to forestall some climate change consequences. The question then becomes what are the most cost-effective ways to adapt to the change. The challenge is especially daunting both because of the uncertainty of the nature and spatial distribution of the possible changes and the long lead times needs for some proposed adaptation efforts.

A key point is that a pro-growth pro-poor development agenda that supports agricultural sustainability also contributes to climate change adaptation in the developing world. Adaptation to any kind of change is easier when individuals have more resources at their command and operate in an economic environment with flexibility to respond quickly to changes. If, as seems likely, the effects of climate change will fall disproportionately on the poor, a policy environment that enhances the opportunities for the poor will also be good for climate change adaptation. The set of pro-growth policies and programs that are needed extend beyond the borders of any country. A common theme of the studies reported above and others is the need for a more flexible and open world economic environment. For developed countries, this means the reduction and eventual elimination of agricultural trade barriers and reduction in agricultural subsidies that indirectly distort world markets. It means a renewed emphasis on foreign assistance that enhances the productive base of the aid recipients, especially agriculture and natural resources. For developing countries, pro-poor, pro-growth policies include increased investment in agriculture, rural infrastructure and market access for farmers with an eye to targeting investments that also assist the poor. Beyond the need for good development policies, four types of policies and programs are needed in the developing world—in agricultural science and technology, water storage and management, rural infrastructure investment and internalizing the negative and positive externalities associated with environmental services.

Agricultural science and technology

Even if climate change were not coming, greater investments in agricultural science and technology are needed to meet the demands of a world population expected to reach 9 billion by 2050 and where large portions of the developing world will have higher incomes and desire a more diverse diet. Agriculture science- and technology-based solutions are essential to meet those demands. Beyond these general needs, is the urgency of an emphasis on crop breeding, including biotechnology, that targets abiotic and biotic stresses to address the likely outcomes of climate change. In essence we need to breed for crops that respond reasonably well over a range of production environments rather than extremely well in a narrow window of climate conditions. One example is the efforts of the Gates Foundation funded project "Stress-tolerant rice for poor farmers in Africa and South Asia (STRASA)," a collaborative effort between the Indian Council of Agricultural Research and the International Rice Research Institute. One of the powerful lessons of the Green Revolution is that the indirect benefits of improved agricultural productivity through job creation and low food prices can be an extremely powerful approach to poverty alleviation. Productivity enhancements that increase resilience in the face of climate change pressures will likely have similar poverty-reducing effects.

Water storage and management

Even without climate change, the world's growing demand for fresh water is outstripping supplies in many parts of the world (Rosegrant, Cai et al. 2002). Improvements in water productivity are critical and climate change, with increased variability in rainfall and changes in its spatial distribution, will exacerbate

the need for improvement in water harvesting, storage, and management. Investments in physical infrastructure are needed, including large and small dams and water retention investments in some parts of the world. Equally important is moving more of the world's fresh water from being an open access resource to one that moves through markets and with property rights assigned. New crop management technologies, such as conservation tillage and integrated soil fertility management practices, will be needed to conserve water in many locations, with the added benefit of increased productivity and likely increases in carbon sequestration.

Rural infrastructure investment

Good agricultural development policies and programs include investments in rural infrastructure, both physical, such as roads, market buildings and storage facilities, and institutional such as extension programs, credit and input markets, and reduced barriers to internal trade. All of these are needed to cope with the uncertainties of climate change.

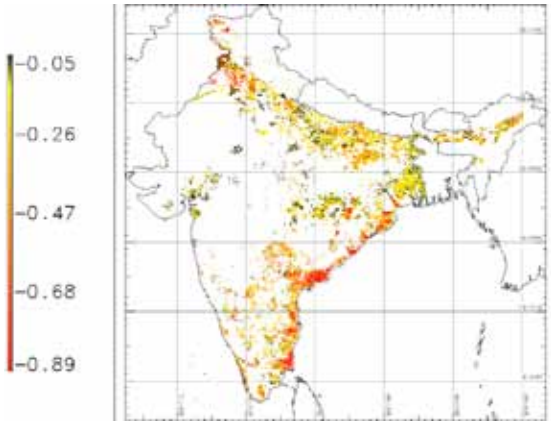
Internalizing the negative and positive externalities associated with environmental services

As human influence and dependence on ecosystems grows, the economic costs of previously innocuous uses of environmental services such as disposal of CO_2 in the atmosphere and human waste in lakes and rivers become unsustainable. The economist's first best solution to a negative externality is to assign property rights to the hitherto open access resource. This is essentially what is happening to the use of the atmosphere as a dump for GHGs. But there are other environmental resources, such as nature's ability to generate fresh water, where growing human demand has outstripped nature's capacity to supply. Whether classical property rights, such as those associated with the ownership of land, or novel rights assignments such as in a cap and trade system of control, the externalities need to be brought to the market place.

Understanding the spatial context

An essential feature of agriculture is that location matters. And the impacts of climate change will be intensely spatial. One of the key research needs to guide adaptation to climate change is to understand the spatial effects, at a scale that policy makers and farmers deal with. Analyses that report results at the regional level are useful for documenting trends but crops are planted on fields and irrigation systems are designed for valleys, not areas that include half a continent. Figure 7 illustrates the importance of spatial information. It highlights areas were changes in irrigation management are likely to reduce Indian methane emissions. This type of analysis can provide valuable insights for regional and local government agencies in identifying locations where mitigation payments would be most effective.

Figure 7: Location of changes in GHG emissions with mid season drying, 2000 (change in mt CO_2e/ha/year)



Source: Own estimates.

The Costs of Adaptation

We are in early days in our attempts to understand the nature of adaptation needs and the associated costs. A recent IFPRI Policy Brief (Fan and Rosegrant 2008) provides some estimates of the investment needs in agricultural research, roads and irrigation to substantially meet the first Millennium Development Goal (MDG1) of halving the proportion of poor and hungry people by 2015 (see Table 1). The report finds that an additional $14 billion per year would be needed to meet MDG1 over baseline investment expenditures. For the entire developing world, this analysis calls for a tripling of research expenditures, a somewhat smaller increase in expenditures on rural roads and only a doubling of irrigation. However, regional results differ. For example, in Sub Saharan Africa, a tripling of investments would be needed with rural road expenditures needing to increase almost 4 times. While these results are only for meeting MDG1, they provide some indication of the magnitude of numbers needed to adapt to climate change. Presumably the challenges of adapting to climate change in addition to meeting MDG1 will cost more. A doubling of expenditures, i.e. to an additional $28 billion per year, is probably a reasonable starting estimate.

Climate Change Mitigation in Agriculture

Globally, agriculture contributed about 14 percent of annual GHG emissions and land use change and forestry a further 19 percent in 2000 (Table 2). However, the relative contributions differ dramatically by region. For example, in Europe, agriculture's contribution is only 9 percent of total European emissions, but in Sub-Sahara Africa, agriculture's share is 13 percent and land use change and forestry contributes over 60 percent.

The relatively recent recognition of the magnitude of agriculture and forest-based GHG emissions and the initial estimates of the relatively low opportunity cost associated with halting deforestation raised hopes that rapid mitigation in agriculture (broadly defined) might offer some breathing room while negotiators address the difficult challenges of slowing emissions from power generation and transportation. The inclusion

Table 1: Annual Total Agricultural Investment ($ billion in 2008 US$) Required to Achieve Significant Progress on MDG1 (Unit Cost/IMPACT Method) by 2015

	Sub Saharan Africa	South Asia	East Asia and Pacific	Latin America and Caribbean	Middle East and North Africa	All developing countries
Baseline Scenario						
Agricultural Research	0.65	0.71	0.21	1.93	0.42	3.92
Rural Roads	0.74	0.13	0.51	1.27	0.09	2.74
Irrigation	0.56	3.84	1.8	0.72	0.74	7.66
TOTAL	1.95	4.68	2.52	3.92	1.25	14.32
Very-High-Investment Scenario						
Agricultural Research	1.83	1.54	3.18	4.06	0.99	11.6
Rural Roads	2.90	0.49	0.43	3.26	0.32	7.40
Irrigation	1.02	5.47	0.81	1.13	1.03	9.46
TOTAL	5.75	7.50	4.42	8.45	2.34	28.46

Source: Table 1 in Fan and Rosegrant (2008).

Table 2: 2000 GHG emissions by sector and region			
	Total GHG emissions ($MtCO_2e$)	**Share from agriculture**	**Share from land-use change and Forestry**
Europe	7,600	9.1	0.4
North America	7,208	7.1	–4.7
South America	3,979	23.6	51.6
Sub-Saharan Africa	543	12.7	60.4
Asia	14,754	14.4	26.8
World	40,809	14	18.7

Source: cait.wri.org, accessed January 22, 2009

of REDD (Reducing Emissions from Deforestation and forest Degradation) formally in the current climate negotiations is a recognition of this potential role. However, as more careful studies of the possible implementation mechanisms emerged, the way forward to reduced deforestation became less clear. It is one thing to implement cap and trade for 1,500 coal fired power plants in the U.S. It is a challenge several orders magnitude larger to find mechanisms to dissuade poor people in developing countries to stop cutting down trees.

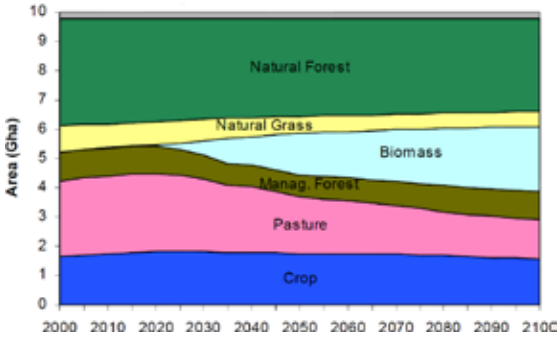
Nevertheless, there are a number of technology and management changes in agriculture that could be potentially highly cost-effective sources of GHG mitigation, including above and below-ground carbon sequestration and reduction of methane and N2O emissions. I discuss several briefly below.

Agriculture-based options to mitigate emissions from other sectors

Plants contribute to sequestration by storing carbon above ground in woody material or below ground in living root structures or organic material such as old roots and plant litter. Changing crop mixes to include more plants that are perennial and/or with deep root systems increases the amount of carbon stored in the soil. Cultivation systems that leave residues and reduce tillage, especially deep tillage, encourage the buildup of soil carbon (e.g., Batjes 2004; Dumanski 2004). Shifting land use from annual crops to perennial crops, pasture, and agroforestry increase both above- and below-ground carbon stocks. And at least some studies find that using more fertilizer, especially in the form of manure, increases soil organic carbon (see for example, Fellman, Franz et al.; Ogle, Breidt et al. 2003), although this also runs the risk of increasing N_2O emissions.

Biofuels are sometimes touted as mitigating fossil-fuel based emissions and are seen in some IAMs as key to reducing GHG emissions. For example, a recent study (Gurgel, Reilly et al. 2007) shows a climate mitigation policy scenario where biomass production is required on about 25 percent of the land area where plants can survive (i.e., excluding deserts and polar regions).

Figure 8: Land use change



Source: Gurgel, Reilly et al. (2007), Figure 5c.

Recent studies, however, have suggested that the GHG mitigation effects of biofuels may be smaller than previously estimated because of indirect effects on land use. A 2008 article in Science (Searchinger, Heimlich et al. 2008) found that maize-based ethanol nearly doubles GHG emissions over 30 years. A later article in 2008 (Nelson and Robertson 2008) estimated that Brazilian land use changes induced by the higher sugar and maize prices caused by biofuels mandates would eventually release CO_2 equal to almost 3 percent of today's atmospheric CO_2.

Options to mitigate agricultural emissions

Agricultural practices that emit greenhouse gasses include cultivation practices that result in soil carbon being converted to CO_2, irrigation that allows inorganic decomposition and the release of methane, and application of nitrogenous fertilizers, both organic and inorganic, that are incompletely taken up by the plant and the nitrogen is converted to N_2O. Reductions in methane emissions from irrigated rice can be obtained by mid-season drying that allows decomposition to take place aerobically (see Figure 7). Nitrogenous fertilizer applications can be timed to reduce release of N_2O to the atmosphere and formulations used that allow more complete update. New crop varieties are being developed that use nitrogen more efficiently.

Combining adaptation and mitigation

One bright spot in an otherwise gloomy assessment of climate change and agriculture is that many adaptation practices also mitigate GHG emissions and in some instances increase agricultural productivity. For example, crop management practices that increase soil organic matter, and therefore sequester carbon, increase the soil's ability to retain water and increase yields. Finding and supporting such practices, with information dissemination, agricultural research, infrastructure investments, and policy reforms, can pay multiple dividends.

Concluding remarks

There is little doubt that climate change will affect the agriculture we leave to our children. Without immediate control of GHG emissions by us, they can expect more rainfall but with increased variability and more intensity, and higher average temperatures and changes in locations of temperature extremes. For many, the outcomes are likely to be negative. Extreme events, such as the melting of the Greenland icecap, are low probability but would engender even more dramatic changes in agriculture and elsewhere, mostly for the worse.

Agriculture could potentially play an important role in mitigation, both by reducing its own emissions and by sequestering carbon released in other sectors. However, the extent of this potential is uncertain and more research, both on sequestration technologies and policy instruments to encourage cost-effective mitigation, is urgently needed. The potential benefits of carbon sequestration in the soil are large and worthy of more careful research at the global level. And given the long gestation times of research, technology and policy instrument trials, it behooves us to start immediately.

Technology solutions, such as more drought resistant crops, varieties that perform well over a range of climatological conditions, bioengineered crops that are utilize nitrogen more effectively, and changes in management practices, will be important to help us adapt to the likely changes.

Equally important is that we allow and encourage the adjustments to any climate-change-induced changes in comparative advantage with an open and flexible trading system. More and more transparent globalization will be at the heart of adaptation with widespread benefits.

Acronyms and their meanings

GCM – global (or general) circulation model

IAM – integrated assessment model

IPCC – Intergovernmental Panel on Climate Change

CO_2 – carbon dioxide

CO_2e – a measure that allows the greenhouse effects of different GHGs to be added up.

N_2O – nitrous oxide. A unit of N_2O has 298 times the greenhouse gas effect of CO_2. Created in agriculture as a byproduct of the use of organic and inorganic nitrogenous fertilizer

CH_4 – methane. A unit of CH_4 has 25 times the greenhouse gas effect of CO_2. Created by anaerobic (without oxygen) decomposition of organic material. Major agricultural sources include irrigated fields and animal flatulence.

ECHAM4 – a GCM. "The ECHAM climate model has been developed from the ECMWF atmospheric model (therefore the first part of its name: EC) and a comprehensive parameterisation package developed at Hamburg therefore the abbreviation HAM) which allows the model to be used for climate simulations." http://www.ipcc-data.org/is92/echam4_info.html

HadCM3 – GCM developed by the UK's Hadley Centre for Climate Prediction and Research

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Agriculture and Water

Bart Schultz[1]

Summary

The coming 25–30 years global food production will have to be doubled in order to maintain food security at the global level. Especially for the emerging countries and to a certain extent also for the least developed countries this implies that to a large extent a transition will be required from subsistence agriculture to food production. In the near and medium term future it will also be required that a substantially larger increase in production will be achieved than continuation of the present trend. In relation to these developments a summarized overview is given of the role of water management for global food production. Improvement and expansion of irrigation and drainage systems, in combination with water saving, increase in water storages and a strong focus on sustainability will play a crucial role to achieve this.

Introduction

The coming 25–30 years global food production will have to be doubled in order to maintain food security at the global level. Most of the increase (80–90%) will have to be realized at existing cultivated land. The remaining would have to come from newly reclaimed land. Especially for the emerging countries and to a certain extent also for the least developed countries this implies that to a large extent a transition will be required from subsistence agriculture to food production. In relation to this development a summarized overview will be given of the role of water management for agriculture, with a focus on global food production. The possibilities of the various options for water management will be presented and reviewed.

Population, population growth and global food needs

By December 2005, there were 6.5 billion people. Global population is expected to grow to some 9 billion in 2050 (Figure 1). Most of the population (73%) lives in emerging countries and most of the population growth in percentage is expected in the least developed countries.[2] In the developed countries, no growth is expected. Population growth is expected to take place predominantly in the urban areas in the emerging and least developed countries. As a result 60% of the worlds' population is expected to live in cities by 2050 (Figure 2) (K.C., 2008). For emerging countries, there is the additional complication that the standard of living is rapidly rising, resulting in an increase in consumption per person and change in diet (Schultz et al., 2005). When we look at the present and probable future needs for cereals Schultz et al. (2009) have shown that the required increase in production would have to be substantially larger then continuation of the present trend.

The above figures imply that higher yields will have to be obtained at existing cultivated land and that at least a substantial part of the subsistence farming in the emerging and least developed countries will have to be transformed into food production for the urban population. In the developed countries this process has in general taken place during the past century. A similar trend may be observed in many of the emerging countries, where for centuries farmers cultivated one ha or less, but where nowadays either farm sizes are rapidly increasing and mechanization is coming up, or farmers shift to specialised cultivations to

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get more revenue from their small plot, or enter into part time farming. Regarding China, for example, simulations show that food security can be maintained without increasing the current water allocation to agriculture (400 km^3/year) (Jianxin Mu et al., 2008). However, the condition is that high yields of cereals need to be achieved (10 tons/ha for maize) with a very strong growth in the next decades. All these developments will have their implications on the lay out and level of service of water management systems. Therefore significant progress in irrigation efficiency and rainwater management needs to be made (Perry, 2007).

The role of water management

At present 45% of global food production is achieved on 1,100 million ha without any water management system, 40% is achieved on 270 million ha irrigated land and 15% at 130 million ha rainfed land provided with a drainage system (Schultz et al., 2005). Table 1 shows percentages of no system, irrigation and drainage per continent and type of country.

In the areas without a water management system rainwater management may result in some improvements, especially in the livelihood of poor farm families. There is, however, no way that these

[3] *Developed countries.* Most of the countries in Western and Central Europe, North America and some countries in Central and South America, the larger countries in Oceania and some countries in Asia;
Emerging countries. Most of the Eastern European countries (including Russia), most of the countries in Central and South America, most of the countries in Asia (including China, India and Indonesia), and several countries in Africa;
Least developed countries. Most of the countries in Africa, several countries in Asia, 1 country in Central America and most of the smaller countries in Oceania.

Figure 1. Population in 2005 and prognoses for 2025 and 2050 (UNDP Population Reference Bureau, 2005, Schultz et al., 2005)

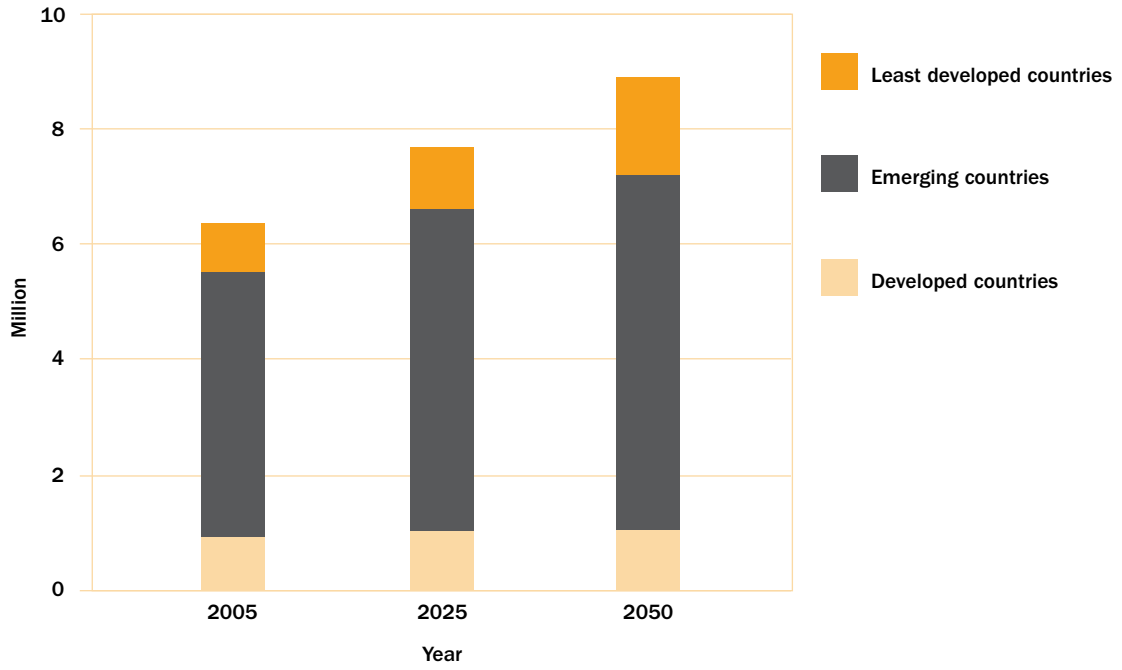
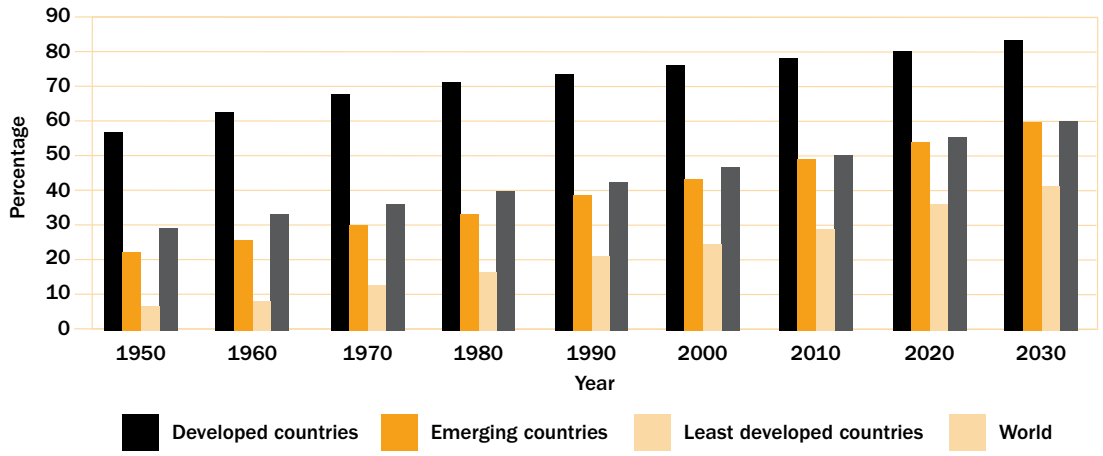


Figure 2. Development of the percentage of urban population in the different types of countries (K.C., 2008)



areas can contribute significantly to the required increase in food production.

In order to achieve the required increase in food production the share of irrigated and drained areas will have to increase. This can be achieved by installation of irrigation or drainage systems in areas without a system, modernization of existing irrigation and drainage systems, installation of irrigation systems in rainfed areas with a drainage system, or installation of drainage systems in irrigated areas (Schultz, 2001; Schultz et al.,

Table 1. Role of water management in agricultural cultivation practices in the different continents and categories of countries (after Schultz et al., 2005).

Continent	Total area in 10^6 ha	Arable land In 10^6 ha	Total population in million	Water management practice in % of the arable land		
				No system	Drainage *	Irrigation **
Asia	3,180	572	3,960	56	10	35
Africa	3,040	225	922	92	2	6
Europe	2,300	301	731	77	15	8
Americas	4,250	391	890	72	17	11
Oceania	852	53	33	91	4	5
World	13,600	1,540	6,540	69	13	18
Developed countries	3,200	372	966	67	22	11
Emerging countries	8,340	1,010	4,810	69	8	23
Least developed countries	2,080	155	766	87	2	12

* In total about 130 * 10^6 ha rainfed and 60 * 10^6 ha drainage of irrigated areas

** Irrigation may include drainage as well

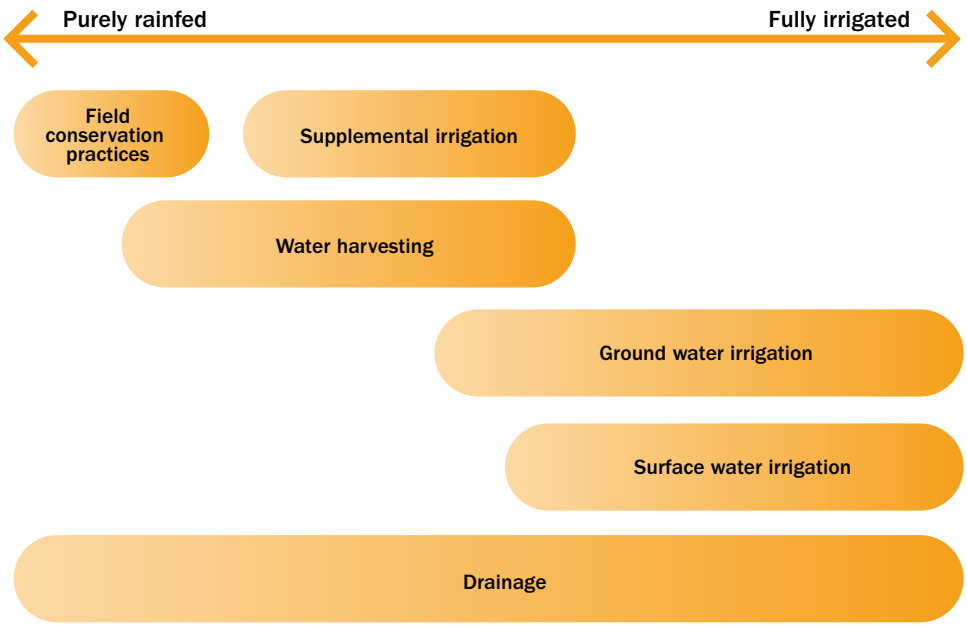
2005). With respect to this also improvements in institutional aspects of system management need to be considered. There is thus a need to consider a series of water management solutions from purely rainfed to large-scale irrigated agriculture (Figure 3) (International Water Management Institute (IWMI), 2007).

Irrigated agriculture counts for some 70% of total water withdrawals on earth. It will therefore be of importance to continue with the efforts to increase the efficiency of irrigation water use. However, even with the most effective measures in the field of water saving it will still be required to increase the withdrawals for irrigation combined with increase in water storages. A complication is that many countries in the arid and semi arid zones have reached, or are already beyond their water carrying capacity: they use more than the renewable amount (Plusquellec, 2002). Pollution of water resources and environmental concerns with respect to the application of agro-chemicals may reduce the potential for their use for agriculture.

Vision on water management for food production

During the Second World Water Forum, which was held in March 2000 in the Hague, the Netherlands, the World Water Council (WWC) has, among others, presented a sector vision on 'Water for Food and Rural Development.' The span of time for the vision was 25 years. In order to achieve the required increase in food production in the framework of sustainable rural development, the following issues with respect to water management were considered to be of major importance (after Van Hofwegen and Svendsen, 2000):

Figure 3. Diverse options for agricultural water management (International Water Management Institute (IWMI), 2007)



- availability of water and availability in space and time;
- links between irrigation, drainage and flood protection and management, and food security, protection of the environment, sustainable rural development and livelihood;
- need for increasing withdrawals with 15–20% to bridge mismatch between demand and supply in combination with water saving and improved efficiency in irrigation;
- need for increasing storages with 10–15%;
- basin wide planning for integrated development and management, inter basin transfers, shared rivers, conflict management;
- governance, legal, institutional and environmental issues;
- stakeholder involvement, youth and women participation;
- financing integrated water resources development and management, modernization and replacement;
- equity, efficiency and economy.

This sector vision would create the basis for the future directions. One cannot forecast the possible directions in specifics, but trends can be seen that may sooner or later result in policy decisions, actual guidelines, or standards for design, implementation, operation, maintenance and management. These directions can be put under the following headings:

- integration in all aspects of water management;
- technological, institutional and environmental developments in irrigation and drainage;
- integrated land use and water resources planning;
- sustainable development;
- acceptable level and size of environmental impacts.

For many centuries, water management was mainly focused on control of water quantity, by means of water supply or drainage. In an increasing number of countries, these days one may speak about control of both water quantity and quality, though at different levels of service, more or less dependent on the respective standards of living. What also can be observed is that water management in many regions is becoming more adapted to diversification in land use, and not predominantly anymore for agricultural use. In future, it is most likely that another step will be taken and countries may aim at an ecosystem approach.

It may be estimated that over the next 25–30 years the contribution to food production may shift from the areas without a system in the direction of areas that are provided with an irrigation and/or drainage system (Schultz et al., 2005). With respect to this it will be extremely difficult to achieve the improvement and expansion in irrigation and drainage systems without affecting environment at all. One will have to live with an acceptable level of impacts and possibly aim at compensatory measures where possible, especially in the emerging countries.

In relation to the improvement and expansion of irrigation and drainage systems there are certain specific issues that deserve attention.
In the developed countries a lot has already been achieved. However, in the emerging countries in particular, several issues are still far from being resolved and significant efforts will be required from the parties concerned (Figure 4) to achieve sustainable solutions. The issues include:

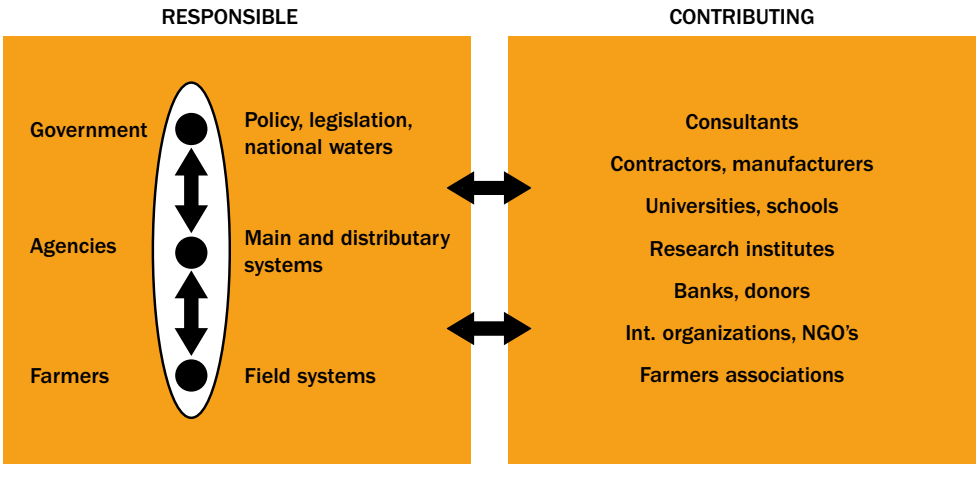
- significant increase in irrigation efficiency and water saving at main and field system level;
- institutional reforms in the direction of stakeholder controlled management and government support for modernization and reclamation;
- modernization to achieve more reliable provisions of water delivery services.

In many countries institutional reforms in irrigation and drainage system management towards stakeholder-controlled management are on-going (Japanese National Committee of ICID, 2000, Czech Committee of ICID, 2001, and Ukraine National Committee of ICID, 2002). Transfer of systems, or of responsibilities are especially taking place in the following regions:

- Emerging countries: Asia, Central and South America;
- Countries with a transition economy: Central and Eastern Europe.

Such transfers are generally desirable, since government controlled organisations in several countries have not really been able to improve the management. Transfers may require quite different approaches (Schultz, 2002). In the emerging countries, there is generally a dominant component of farmers' population. In such cases the transfers concern transfer of responsibility and may be of ownership of parts of the systems from the government to the farmers. In these countries a significant part of the systems is more than thirty years old. Therefore transfers will have to go hand in hand with modernization. However, in the countries with a transition economy, there are specific problems, like: unsuitable layout of systems, which is mostly based on the former large-scale type of agricultural production, uncertain future of the agriculture sector, required funding of modernization and resulting operation and maintenance, lack of good governance, unaffordable pumping systems and environmental degradation (after ICID Yalta Declaration, 2002). In some countries, there is even not a clearly identified

Figure 4. Indicative schematization of actors in agricultural water management (Schultz, 2001)



farmers group. These issues make the transfer process quite complicated.

In several of the countries with a transition economy a complete agricultural reform will be required, before irrigation or drainage system management transfer can be successfully planned and implemented, while in these countries the farmers are completely uncertain about their future and therefore not in a position to commit themselves to responsibilities that they cannot afford. The economic and financial questions that arise with respect to sustainable irrigation and drainage system management after transfer, concern especially to:

- determination of best modernization options and modernization cost;
- resulting cost and efforts for operation and maintenance of the modernized systems;
- full cost recovery, or sustainable cost recovery (Tardieu and Préfol, 2002 and Tardieu, 2004);
- cost sharing and capacity to pay.

Sustainablity of water management for global food production

The issues of cost sharing and capacity to pay are the more important in light of the sustainability of the modernization and transfer activities. In order to promote modernization and transfers in the emerging countries governments are increasingly funding programs and projects with respect to the modernization of irrigation and drainage systems from their own budget and not anymore through donor funding. Striking examples are China and India—together housing about one-third of the worlds' population—where huge investments are being made in inter basin water transfers and modernization of irrigation systems. Similar developments may be observed in many of the other emerging countries.

In the least developed countries the situation is quite different. In these countries the application of irrigation and drainage is only taking place at a marginal scale (Table 1). The issues here are not so much the transfer and modernization, but how can sustainable irrigation and drainage systems be developed in future. For these countries it seems to be advisable to focus on small and medium scale types of systems that can be operated and maintained by individual farmers, or farmers groups.

We are more and more concerned about the sustainability. In the past, we did not have to be so much concerned about this, but increasing population pressure, changes in food production practices, and over-exploitation, or even exhaustion of resources in some extreme cases have increased the concerns. The following tendencies can be observed that in different ways will have an impact on the sector:

- requirement of higher yields per ha;
- increase in farm sizes, higher value crops, or part time farming;
- mechanization in agriculture;
- competition for water;
- increased application of fertilizer and pesticides;
- depletion of surface and groundwater resources.

All the irrigation and drainage projects have side effects. The challenge has been and will be to keep the negative environmental impacts at an acceptable level and to support positive environmental impacts as far as reasonably possible. Of special importance for the sector are:

- controlled application of fertilizers and pesticides;

- quality criteria and quality control for drainage waters;
- prevention of waterlogging and salinization;
- prevention of depletion of surface and groundwater resources.

Better water management, application of fertilizers and pesticides, soil treatment practices, new varieties and genetic manipulation can contribute to the required increase in yields per hectare. However, there are upper limits to each of these possibilities. Especially the application of fertilizers and pesticides has to be done in a controlled way in order to prevent harmful effects on the water quality.

Analysis

The demand for food production cannot be met with the existing structure and anticipated trends in irrigated and rainfed production. This needs to change significantly, at national, regional and global levels. The optimal mix of small-scale and large-scale systems under prevailing and expected future conditions will have to be identified. With respect to this interactions between agriculture and natural resources need to be considered. This will especially be the case in Asia and in the Near and Middle East where the density of population is the highest.

At global level roughly 7,000 billion m^3/year of water are at present required for food production. This is roughly 1,100 m^3/person/year of which 1,800 billion m^3 are supplied by irrigation, the other 5,200 billion m^3 come directly from precipitation. Producing 1 kg of cereals costs from 500 to 1,500 liters of water. Producing oil or meat costs much more (to the total process involved) from 3,000 to 15,000 liters of water per kg produced. Producing 1 kcal requires roughly 1 liter of water. Each person requires a minimum of 2,800 kcal/day i.e. 2,800 liters/day or 1,020 m^3/year. Increasing the productivity of agricultural water is nevertheless possible and required. With respect to water management two main ways are to be considered:

- *Integrated agricultural water management*, preferably at river basin level in combination with efficiency improvements in irrigation systems. Increasing hydraulic efficiency of irrigation systems by reducing 'losses', improvement of the systems, change of irrigation technologies, improvement of operation and maintenance;
- *Increasing low yields* (i.e., less than 2 tons/ha) which generally imply excessive evaporation. If all yields would be above 2–3 tons/ha, water use at the global level would be reduced by about 1,500 billion m^3 (Schultz et al., 2009). Increase in water use efficiency is mainly caused by reduction of evaporation from the soil, due to the better cover of the plants and the resulting increased interception.

Globally water is not a limiting factor for agriculture. But heterogeneity prevails and some countries will increasingly face different forms of water scarcity. Future needs for water for food are huge and up-to-date water management systems will be required at a large scale. With respect to the water management options the following can be stated:

- especially in emerging countries modernization of agricultural water management (technical, management, institutional, financial, environmental) will be required at a large-scale to achieve the required increase in food production;
- it has to be analyzed how institutional and technical water management improvements will contribute to increase the food production;
- it has to be analyzed what types of investments are necessary to develop additional water

resources including non-conventional and to modernize existing irrigation and drainage schemes to improve water productivity;

- special attention needs to be paid to the potential role of rainfed agriculture—either without a system, or with water harvesting, soil conservation, or drainage—in order to let it contribute more effectively to food security and improvement of livelihoods;
- it has to be determined what policies and actions are needed to ensure the sustainability of water resources and river basin services that underpin the increases in agricultural productivity that must be achieved.

The issues as outlined before will most probably result in a set of development scenarios for global food production and the supporting measures in the field of water management. The required increase in food production means a range of water for food between 10,000 and 14,000 billion m^3/year. This depends to a large extent on the capacity of small-scale agriculture to increase productivity, on the modernization and expansion of irrigation and of modernization and installation of drainage systems in either rainfed or irrigated agriculture areas.

At each level of this continuum, the issues of water storage, artificial recharge and efficiency need to be considered, depending on the local conditions. Especially in the emerging and least developed countries it will be of importance to analyse how water can be managed more effectively for sustainable agriculture to continue to be a key pathway out of poverty and means to achieve food security. It is basically possible to maintain food security in the near, mid-term and maybe even in the long-term future. However, one may expect that at least for the near future the costs will remain at the present high level and may even further increase.

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Agriculture and Virtual Water

Alexandre Le Vernoy [1]

Introduction

The paper proposed by Prof. Schultz has proven to be very convincing by portraying the global water picture. And by providing persuasive argument and comparison of the water situation in the great region of the world. The purpose in this note is to scale down from the big picture to the specific situation of the European Union and to add some general comments to the propositions made by B. Schultz.

Nexus

It is better to be roughly right than precisely wrong. But, when it comes to water, are we yet close to being roughly right? While newspapers swarm with gloomy statements on world water scarcity, past studies on water supply for the future tend to be even more depressing. In reality, we do not have a clear knowledge in terms of future availability. Evaluating a volume at a specific time is very difficult, and predicting future human water needs depends much upon choosing the most credible scenario. Moreover, forecasted water withdrawals for 2000 have been divided by two since the first study in 1957:

A global assessment based on yearly and worldwide averages merely raises awareness. It may not be the most suitable way to depict the situation where water is first and foremost a local issue. By all means, this type of indicator only shows physical water scarcity. Yet, water scarcity results from a management deficiency problem. While the European Union may not on average feel concerned about water shortage, there is a growing water gap between some European regions. For instance, Spain has a water competitiveness index of 885 Inhabitant per hm^3 per year against 599 for French inhabitants.[2] And, this national level does not quite capture the difficulties inside a country or the dynamic of water sharing.[3] This is why, water management, strategies and policies are designed at

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[2] Ref: FAO Aquastat, online database. Available at http://www.fao.org/nr/water/aquastat/data/query/index.html

[3] France is selling water form the Rhone to Catalonia, a thirsty northern autonomous community.

Table 1: Water Scenarios for 2000

Authors	Year of publication	Projected global water withdrawals for 2000 km^3 per year
Nikitopoulos	1967	6730
L'vovitch	1974	6325
Falkenmark & Lindh	1974	6030
Kalinin & Shiklomanov	1974	5970
De Mare	1976	6080
Shiklomanov & Markova	1987	5190
World Resource Institute	1990	4660
Shiklomanov & Markova	1996	3940
Shiklomanov	1998	3717

Source: Gleick, (1999).

the basin level where all actors' activities are to be included into an integrated management approach. The very first assessment states that every region of the world, every continent will have to face a certain level of water stress. If it's not already the case, some parts of the world will have to deal with the food and water nexus in an acute way never experienced to date.

Ignoring the exact amount of the supply leads us to manage what's available with caution and to rely on a demand-oriented approach. Concerning future water demand, expectations are two-fold. First, the growing world population is already increasing rapidly in countries experiencing water stress. As noted in the Human Development Report of the UN[4] (2006) the description made about the state of world water resources is remarkably comparable to a Malthusian analysis of food production in the 19th century. However, and as noted above, scarcity issues are primarily the consequences of mismanagements of water resources.[5] The second aspect is the already shifting diets worldwide. As average wealth is increasing, the amount of water consumption per capita tends to increase. It is true for domestic purposes but also for industrial and agricultural purposes. It is particularly obvious for agriculture. A growing percentage of the world population's calorie intake is based on meat. This trend is even more pronounced in most advanced developing countries.[6] As livestock products are increasingly fed with cereals, the water content of a calorie of meat is exploding.

Plexus

The real extent of these issues has to be clarified and prioritized in order to address them in a responsible way that fits into an integrated interplay. As noted by Prof. Schultz there are several points of crucial importance. Increased water needs for agriculture may be compensated with higher water productivity and efforts have to be intensified with the view to keep eyes on the right target. Irrigated agriculture benefits from very high yields in almost all regions

[4] On page 133

[5] Hoekstra, A.Y. & Chapagain, A.K. (2003). *Virtual water flows between nations in relation to trade in livestocks.* The Netherlands.

[6] Also in India as Indians rely on vegetarian diets.

Figure 1: Cereals consumption in g per day per cap (1961–2003)

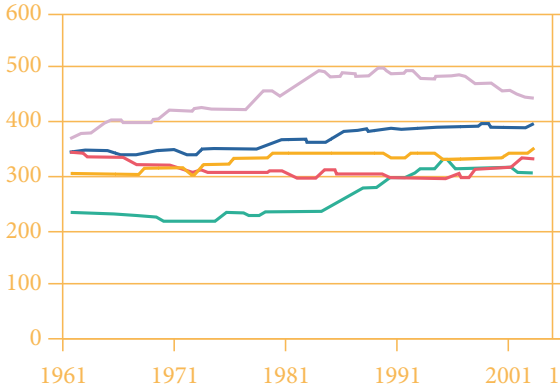
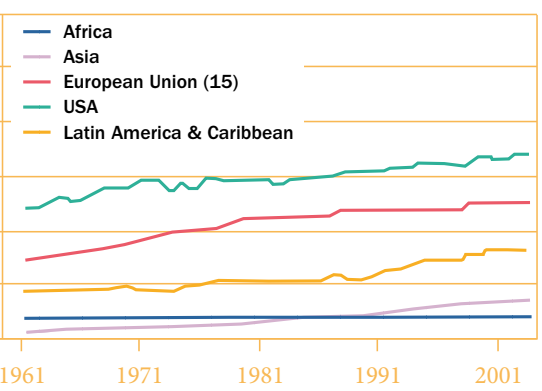


Figure 2: Meat consumption in g per day per cap (1961–2003)



Source: Own calculations based on Food and Agriculture Organizations–Online Database (FAOstat)

Table 2: Rainfed vs. Irrigated yield and production for cereal in 1995					
	Irrigated yield ton/ha	**Irrigated production** million tons	**Rainfed yield** ton/ha	**Rainfed production** million tons	**% Rainfed production**
USA	7,04	57,8	4,82	263,4	82
EU (15)	6,32	59,4	4,79	124,4	67,7
Latin America	4,07	30,6	2,07	86,4	73,8
Sub-S Africa	1,71	3,4	0,83	44,3	93
East Asia	4,2	271,1	3,54	95,7	26,1

Source: Rosegrant et al, (2002).

of the world. On the other hand, rainfed agriculture lacks both innovation dynamics and efficient management. It has to be noted that European agriculture relies on rainfed agriculture for a significant part of its food production. For cereals rainfed production is evaluated to over 65% of the whole production.[7]

Innovation to unlock the rainfed agriculture potential may come from several techniques including supplemental irrigation through rainwater harvesting and field conservation. But the main point is to conquer efficiency. There are many management habits in agriculture that contribute to an inefficient use of water resources. For instance in the EU, the implementation of irrigation grants based on agricultural yields through the CAP reform in 1992 resulted in excessive support of intensive irrigation (Boulanger 2007) which was detrimental to European rainfed agriculture.

One last aspect of water and agriculture is the question of water and international trade. This idea materialized by the concept of virtual water is one of a few tools that help reconcile both the demand based and the supply based approaches into a single vision. It also offers a link between local water specificities and a more global approach to agriculture.

Focus: Linking food production and water needs through trade

It is now acknowledged that a calorie requires about one liter of water to be produced.[8] If we invite everyone at nature's great table, will there be enough water? Clearly, there will be enough water to sustain world's population globally. And the idea is that local water gaps may be partly secured through trade. The concept of virtual water is a powerful tool to raise awareness concerning the impact of international trade on water resources uses (Allan 1997). Virtual water is the volume of water required to produce a good. In agriculture for instance, the specific water demand of a crop varies significantly from one country to another, in space and time and according to soil and climatic conditions. The idea behind this concept is that an import generates a virtual water flow and consequently water saving for the importing country. In 2000, the European Union imported 592 km^3 of water through international trade. In the meantime, the EU exported 420 km^3 of water creating a net flow of virtual water of 171 km^3. The EU is importing almost a quarter of its available water resources. Trade may have an alleviating impact on water stress intra-regionally, inter-regionally and globally whenever a specific trade policy is enabled to favor the most water-efficient producer.

[7] This number is for EU–15.

[8] International Water Management Institute, 2007.

Table 3: Regional virtual water flows

	Gross virtual water flows ($10^9 m^3/yr$)		Net virtual water import ($10^9 m^3/yr$)				Water resources total renewable ($10^9 m^3/yr$)
	Total		Trade of crop products	Trade of livestock products	Trade of industrial products	**Total**	
	Export	Import					
Eu (25) [1]	**420**	**592**	162	–9	18	**171**	2,053
Nafta	**346**	**261**	–78	–7	1	**–85**	6,410
Asean (+3) [2]	**213**	**308**	62	37	–5	**94**	10,382
Mercosur (+5) [3]	**159**	**57**	–90	–17	4	**–102**	16,345

Source: Calculations based on data extracted from FAO Aquastat & UNESCO IHE databases
Note: [1] Though data are for 2000 (on average) we included all 25 European countries as of 2004 & 2007 enlargement's phases
[2] ASEAN + China + Japan + South Korea
[3] MERCOSUR plus associated countries (Bolivia, Chile, Columbia, Ecuador & Peru)

In Europe, water availability is uncorrelated with virtual water flows. Studies show a threshold of 1500 cm/cap/yr below which a country's cereal import become strongly and inversely correlated with its renewable water resources (see Yang et al. 2002). This is typically the case with Middle East and North African countries, which are trading partners for the EU. It means that EU's agriculture policy has a responsibility to build sustainable agricultural water policies inside the borders but may need to beggar thy neighbor outside the border. Though the EU is well placed to play an important role in the field of water savings through trade (see Le vernoy 2006), agricultural liberalization should be combined with appropriate domestic policies that contribute to enhanced virtual water flows towards countries that are less efficient in the use of their water resources.

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Agriculture and Energy

Michael A. Levi [1]

Introduction

Biofuels are receiving increased attention worldwide. The International Energy Agency projects that global consumption of ethanol and biodiesel will increase nearly fivefold over the next two decades, accounting for four percent of global transportation fuels by 2030, up from one percent today (IEA, 2008). Growth is expected to be even more pronounced in Europe: biofuels consumption is expected to quadruple there even as total oil consumption falls, vaulting biofuels' share of the transportation fuels market from one to seven percent. Similar trends are forecast for the United States.

These "business as usual" projections, however, are extremely tentative. They are based on hard-to-make predictions about future commodity prices and, critically, on the assumption that no new policies will be put in place to promote biofuels growth. But the future will almost certainly be different. Concerns about energy security, climate change, and food prices, will yield new policies in Europe and elsewhere, which will in turn change the biofuels landscape. The most bullish pictures see biofuels providing nearly half of the world's liquid transportation fuels by 2030 (Vattenfall, 2007). Other estimates of a carbon-constrained world foresee a much smaller role for biofuels, but one that is still substantially greater than in the business as usual case (IEA, 2007; IEA, 2008).[2]

This paper explores the basic factors and policy decisions that will shape the future of biofuels. It then provides several basic recommendations for policymakers. Crafting the best biofuels strategy possible will require policymakers to carefully balance multiple objectives and to draw on policy tools from beyond the biofuels sphere.

Energy Security

Concerns about overdependence on oil have historically been the primary driver of biofuels policy. Oil security concerns typically have several elements.

Countries have long worried about the possibility of oil supply cutoffs, which can, in theory, wreak economic, social, and political havoc. These concerns trace back to the 1970s. They are less salient, however, today. Oil is traded on global markets; as a result, lost supply from one source can be replaced by imports from another (though typically at higher prices.) Wealthier oil-importing countries, including those of Europe, have also developed a system of Strategic Petroleum Reserves (SPRs), several-month stores of oil that can be released during supply crises to blunt those crises' impacts.[3] Concern about supply cutoffs not a good reason to promote biofuels.

Nonetheless, the lack of flexibility in fuel options for transportation can lead to high and volatile prices. That, in turn, hurts economic growth. Expanding fuel options—including through investment in greater use of biofuels—can, if done right, help moderate and stabilize fuel prices. In addition, substitution of domestically produced biofuels for imported oil can help alleviate balance of payments problems, again with positive economic effects. High oil prices and consumption levels also enrich many corrupt and undemocratic regimes. International security is generally enhanced if greater production

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[2] (IEA, 2008) projects increased biofuels use in its climate-constrained scenarios but does not provide numbers. The "Alternative Policy Scenario" in (IEA, 2007), which is consistent with stabilization at 550 ppm CO2e, projects an increase in biofuels' share of global transportation fuels in 2030 from 3% to 6%.

[3] By minimizing the potential impact of any supply shock, SPRs also serve as a deterrent to politically motivated supply cutoffs.

of biofuels lowers oil prices and lowers global oil imports from such countries.

Expanded production of reasonable-cost biofuels is, however, only one of many policy levers available for addressing these energy security challenges. Curbing overall demand for liquid fuels, whether by using energy more efficiently in transportation or by shifting to greater use of electricity to power cars and trucks, will be a critical element of any effective energy security strategy. The legitimate role of biofuels will also depend on whether they can be produced at a reasonable cost compared to gasoline and diesel. That in turn will depend both on how the price of oil evolves, on how biofuels technologies and business models develop, and on the future prices of inputs for biofuels, including feedstocks, energy, fertilizer, and land. It is thus impossible to dictate now with any confidence precisely how central biofuels should be in future energy security strategy.

While oil is central to biofuels' energy security calculus, it is also important to remember that natural gas should be part of biofuels' energy security equation. Current biofuels technologies generally consume large amounts of natural gas in making fertilizer and in processing feedstock into fuel. Natural gas consumption presents an energy security problem in Europe, and greatly expanded biofuels production could exacerbate that. (It is worth noting that natural gas is less of a security problem in the United States, since most supply there is either domestic or from friendly and stable states.) Still, biofuels will not be a central determinant of European energy security *vis-à-vis* gas.

Climate Change

The second big force shaping biofuels policy is concern over climate change. Emissions of greenhouse gases—primarily carbon dioxide (CO_2) produced by burning coal, oil, and natural gas to produce energy—are steadily accumulating in the atmosphere, leading to temperature increases and corresponding changes in climate.

Greenhouse gases are different from ordinary local pollution: they typically remain in the atmosphere for decades or centuries after they are emitted. As a result, unless global emissions are slashed in the coming decades, the world will probably see severe temperature rises and a wide range of associated climactic impacts.

Biofuels have the potential to play a significant role in addressing this predicament, since substituting biofuels for oil will generally lead to lower net emissions. The plants that are used to make biofuels absorb carbon dioxide from the atmosphere as they grow; that carbon is stored in the plants themselves as well as in the underlying soil, reducing global greenhouse gas concentrations. At the same time, greenhouse gases are emitted in cultivating biofuel crops, in converting them to liquid fuel, and, ultimately, in burning ethanol or biodiesel in vehicle engines. What is the net result? Viewed over its full "life cycle"—from the planting and growth of biofuels crops to burning the resulting biofuels—emissions are generally lower those from the gasoline or conventional diesel that they displace. How much lower depends strongly on the particular feedstock used to make biofuels. Ethanol made from corn, for example, probably reduces net greenhouse gas emissions very little; ethanol from sugar beets roughly halves emissions; and ethanol made from sugarcane cuts emissions by about ninety percent (Sims, 2008).

This logic, however, is not without problems. In many cases, land is cleared specifically so that biofuels crops can be grown, which releases large quantities of greenhouse gases into the atmosphere. For example, conversion of peat to growing palm for biodiesel is responsible for a large fraction of Indonesian greenhouse gas emissions. Those

emissions can overwhelm any savings that accrue from shifting from conventional oil to biofuels. Indeed even if sensitive land is not explicitly converted to biofuels cultivation, increased production of biofuels can lead indirectly to increased emissions. (This phenomenon is referred to as "indirect land use change.") For example, in Brazil, agricultural pasture is often converted to growing sugarcane for ethanol production. Ranchers now require other land to graze their cattle on—and if they develop that land by clearing rainforest, as is often the case, very large emissions result.[4]

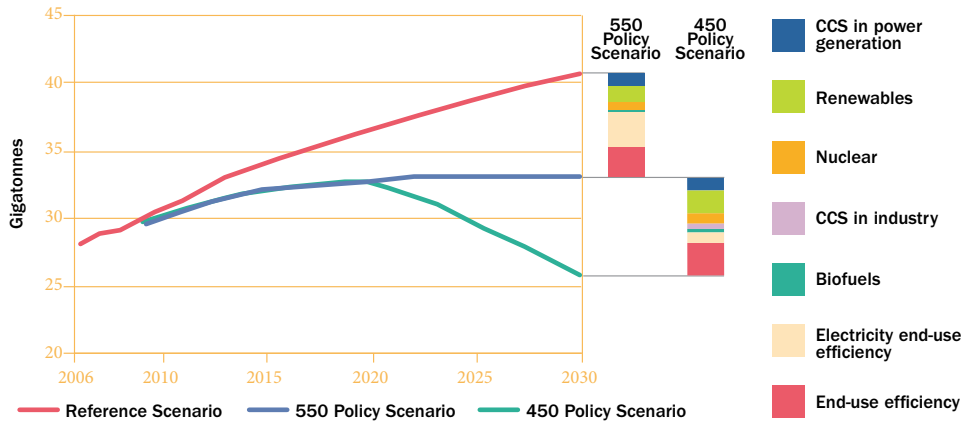
Quantifying these phenomena is notoriously difficult. This is particularly true in the case of indirect land use change, where complex models must be used to predict how biofuels production in one place will affect land use elsewhere. In perhaps the most prominent analysis, a group of researchers estimated that emissions savings from U.S. production of corn ethanol would take 167 years to make up for emissions from indirect land use change. They also estimated that if ranchers displaced by Brazilian sugarcane cultivation decided to convert rainforest in order to gain new grazing land, it would take 45 years for the savings from ethanol use to make up for the initial emissions (Searchinger, 2008). This analysis has, however, been vigorously challenged on a wide range of grounds.[5] While it is clear that converting carbon-rich lands such as tropical forest to produce biofuels has a net negative climate impact, the net impact of converting less carbon-rich lands, especially if done with care, is still unknown (Kim, 2009).

Biofuels are, of course, only one of many options for cutting greenhouse gas emissions. Energy can be consumed more efficiently, electricity can be produced in ways that yield lower emissions, industrial plants can adopt technologies that lower their pollution, and new fuel sources—including biofuels—can be used in transportation. Figure 1 shows one set of authoritative predictions for the role biofuels might play. The precise mix, however, will depend on how

[4] This paper does not address the impact of biofuels production on water use, which has also raised environmental concerns.

[5] In particular, see the letters to the editor in response to (Searchinger, 2008) in several subsequent issues of *Science*.

Figure 1.



The top line shows global emissions projections for "business as usual." The bars on the right show the roles of various emissions-cutting technologies in moderate (550) and aggressive (450) policy scenarios. Note that increased vehicle fuel efficiency is included in "End-use efficiency." Figure from (IEA, 2008).

technologies evolve and on policies governments choose. That mix is impossible to predict.

Food Security

The third major factor shaping biofuels policy will be concern about its expected effect on global food prices. Policies that increase demand for biofuels also increase demand for feedstocks. If those feedstocks have alternative uses as food (as is the case, for example, with corn- or wheat-based ethanol or with soy-based biodiesel), this in turn drives up food prices. Even biofuels production that uses feedstocks that are not in demand as food can lead indirectly to increased food prices. Cultivating biofuels crops on high-quality land that might otherwise have been used to grow food, for example, increases the cost of good land and hence food prices. Fertilizer-intensive biofuels production similarly drives up the cost of growing many other crops.

Skyrocketing food prices have focused policymakers' minds on this tension between food and biofuels, though the global economic slowdown has brought a temporary reprieve. While there has been much debate over the underlying causes of the rise in agricultural commodity prices that occurred over the last several years, there is a general consensus that government support for biofuels played at least some role. More important, there is broad agreement that all else being equal, massive future increases in biofuels production could have severe effects on food prices worldwide. Unless policymakers can resolve that tension, there will be substantial and legitimate pressure to curtail efforts to promote biofuels growth.

The near-term challenge may be particularly acute, since currently mature biofuels technologies all use land that could otherwise be cultivated for food production. This limits the tools available to policymakers, leaving them with two basic options for dealing with the tension. The first involves lowering demand for biofuels by cutting back existing subsidies and mandates biofuels production. Any such step would be controversial both because it would affect agricultural communities and because concern about energy security makes policymakers hesitant to scale back their ambitions for moving away from oil. The tension between food and fuel might also be defused if global agricultural productivity could be improved and if the functioning of international agricultural markets could be enhanced. While such developments would not remove the effect of biofuels on food prices, they could offset them through other means. These steps would also have the benefit of helping keep food costs down even if the role of biofuels in causing high food prices turns out to be overstated.[6]

Technological Prospects

The future of biofuels will be determined in large part by how biofuels technology develops in the coming decades. Biofuels on the market today, including ethanol made from sugar beets, corn, wheat, and sugarcane, as well as biodiesel made from soybeans, rapeseed, and palm oil, are referred to as first generation biofuels. Such biofuels, however, tend to be relatively ineffective at cutting greenhouse gas emissions, because producing them consumes large amounts of energy and hence generates substantial emissions. Many are also relatively expensive, limiting their value on the energy security front. The notable exception to these rules is sugarcane ethanol, which takes relatively little energy (and is also inexpensive) to produce; as a result, switching from gasoline to sugarcane ethanol is broadly believed to be a cost-effective way of cutting emissions—though concerns about

[6] In the very short term, of course, the global economic downturn will keep food prices relatively low regardless. But if policymakers should take advantage of the opportunity to fix the underlying problems, high food prices are almost certain to reoccur.

indirect land use change still plague even this particular biofuel.

The limitations of first generation biofuels have prompted policymakers, entrepreneurs, and scientists to focus increasingly on so-called second generation biofuels. These biofuels, none of which are produced at commercial scale yet, do not exploit feedstocks that have alternative uses as food. Instead, they use so-called "cellulosic" feedstocks. These could include crop residues (such as cornhusks) and woody biomass (such as wood chips).

Cellulosic feedstocks have the potential, in theory, to reduce the lifecycle emissions from fuel production, thereby making biofuels better candidates for cutting greenhouse gas emissions while strengthening energy security. This is because the feedstocks involved would require either less energy to grow or less energy to process into fuel—or both.[7] (Using crop residues, for example, would essentially eliminate any emissions associated with growing feedstocks specifically for fuel.) At the same time, by focusing either on using land that is not suitable for growing food, or by using the same land for food and fuel production simultaneously, second generation biofuels present the possibility of addressing the tension between food and fuel production.

It remains to be seen, however, whether second generation biofuels will fulfill their promise. Breaking down cellulosic biofuels into a form that can be converted to fuel is difficult, and while a variety of technology options are well understood, none have been demonstrated at reasonable cost or at commercial scale. The ultimate fate of second generation biofuels will depend on whether costs can be brought down to competitive levels and on whether the scope of production can be expanded by many orders of magnitude. This will depend not only on scientific developments but also on the business models that develop around different technologies and feedstocks, which themselves will have major impacts on viable cost and scale of biofuels production (Sims, 2008).

A shift from first to second generation biofuels will also have important implications for agriculture. First generation biofuels are generally grown on agricultural lands; they also use many of the same inputs that traditional agriculture does. Demand for first generation biofuels thus tends to have a strong impact on agriculture. The impact of second generation biofuels is, however, less clear.

Some paths promise new commercial opportunities for farmers. Demand for crop residues that can be converted to fuel, for example, will make those crops more valuable.

Meanwhile, if lands that are currently used only in some seasons can be put into use producing biofuels feedstocks during the rest of the year, that will open up new opportunities too. Other trends will be neutral: for example, growth in the use of wood chips for fuel production will leave farmers largely unaffected, since these inputs for making fuel will come from a different sector. That said, if second generation biofuels become viable, demand for first generation biofuels may drop, removing opportunities that currently exist for many farmers. The paths that ultimately materialize will depend in part on where technology investment is directed and in part on the luck of which technologies turn out to be most promising.

What Role Should Governments Play?

Governments have to date supported biofuels development through a mix of subsidies and tax incentives for both producers and consumers of biofuels. But while singling out biofuels for subsidies and mandates may appeal to the narrow interests that benefit from them, these policies cost taxpayers

[7] Crops that needed less fertilizer would also reduce emissions of nitrous oxide, a potent greenhouse gas.

large sums of money and can also drive up gasoline and diesel prices at the pump. They should be phased out over time—indeed it is widely agreed that current policies are inefficient at best (OECD, 2008). But what approach is wisest?

Relying purely on markets is ill advised. Biofuels may deliver significant benefits for climate change and energy security, but, left alone, markets will not fully value those. Without special incentives, then, biofuels production may be substantially less than the social optimum. Many of the most promising future biofuels developments will also require substantial investment in research, development, and demonstration (RD&D) activities. Private actors, however, tend to underinvest in RD&D because of the high risks involved and because the benefits of success accrue not only to them but also to their competitors. Lack of government policy that addresses this market failure will also lead to less than optimal investment in biofuels. Meanwhile, even if biofuels subsidies and mandates were eliminated, biofuels development might still ultimately place strong and undesired pressure on food prices—an outcome that government policy (including the promotion of properly functioning agricultural markets) would need to address.

This suggests that government has three basic roles to play. First, it should take steps to make sure that the energy security and climate change benefits of biofuels are directly reflected in their market prices. On the climate change front, this can be done by including biofuels production and consumption in any cap-and-trade or other carbon pricing scheme that is used, which would raise the price of gasoline relative to that of biofuels. On the energy security front, to the extent that governments are focused on oil consumption, it can be accomplished by levying lower taxes on biofuels than on traditional gasoline. Done right, neither of these steps would be as strong a support for biofuels as the current subsidy and mandate regimes are, since they would let other solutions to energy security and climate change problems compete in the market. But they would still lead to substantially greater use of biofuels that the market would if left to itself.

Second, governments should support RD&D in second generation biofuels both through direct investment and by providing incentives (beyond carbon and gasoline pricing) to private sector innovators. Subsidies and mandates may have some role to play here in order to provide the market scale necessary to attract sufficient investment in innovation. But this should be done carefully, with an eye toward phasing out such support as markets mature, and in a context where other targeted policies are used whenever possible. Meanwhile, it is important to ensure that investment in new technologies is not overly concentrated in any particular country or region. Different places may prove promising for different feedstocks and—equally important—different supply chain and business models. International cooperation in RD&D can also promote harmonized standards for assessing the emissions from different technologies and processes, which in turn could help facilitate international biofuels trade.

These steps will help the two critical downsides of biofuels promotion just discussed. But governments must also look beyond biofuels policy. They should adopt measures that broadly discourage tropical deforestation and other damaging land use change, which would blunt concern that biofuels cultivation is leading to climate-harming activities. As a start, consuming countries should adopt policies that avoid promoting the use of biofuels produced on recently converted carbon-rich land. This includes much of the biodiesel Europe currently produces using Southeast Asian palm oil.

That will not, however, address the challenge of indirect land use change. To confront that problem, government should work to develop incentives for

countries that avoid dangerous land use change and deforestation, something that is under active discussion in international climate negotiations. This would tend to steer new land conversion—whether directly or indirectly the result of biofuels cultivation—away from sensitive lands. Such efforts should combine financial compensation for countries that leave potentially valuable land undisturbed with technical assistance in establishing property rights and enforcing land-use laws that encourage sustainable land use.

Governments should also confront the tension between food and fuel by working to strengthen global agriculture. Serious efforts to improve agricultural productivity will require, among other things, promoting agricultural biotechnology. Improving the functioning of international agricultural markets will also require that the West, including the United States and Europe, cut back on subsidies and tariffs. In the long term, as technologies for cutting emissions and improving energy security develop, and as the factors driving food prices become better understood, policymakers may also want to deliberately discourage the dedicated use of agricultural lands for fuel production. In the near-term, if renewed economic growth leads again to dangerously high food prices, governments will need to seriously consider relaxing their biofuels mandates on a faster schedule than they might otherwise adopt.

Despite much recent criticism, biofuels have the potential to play an important role in addressing our energy security and climate change challenges. But they will only do so effectively—and responsibly—if we think broadly and carefully in designing policy and begin to shift course now.

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Agriculture, and Food Security, Safety and Quality

Johan F.M. Swinnen[1]

Introduction

In the Agriculture 2020 Conference outline the key questions for session 5 on "Agriculture, Food Security, and Food Safety" are summarized as follows:

"It is important to distinguish food security (a sufficient supply of agricultural products) from food safety (the availability of "good" quality of food). What specific instruments should be used for the former and the latter? What is the appropriate balance between public intervention and markets, between regulations (national, regional, and multilateral) and private standards?"

In addressing these issues I start by critically examining these definitions of both food security (i.e. "a sufficient supply of agricultural products") and food safety (i.e. "the availability of 'good' quality of food"). This is a crucial prerequisite for the development of a coherent policy framework. The issue that I will address first is the balance between these various policy measures.

Policy focus and the EU public

Traditionally the focus of "agricultural policies" has been very heavily on supply and income issues, and only recently have safety and quality received more attention—and even then usually not under the umbrella of agricultural policy but rather as part of consumer and health policies. An important policy question is whether this bias is consistent with public demands—and whether it needs adjustment.

Most of the agricultural policy attention in the past has gone to agricultural producer issues i.e. mostly about CAP subsidies and trade interventions.

Consumer and taxpayer interests have received some attention in this framework, but other issues less. This is an interesting observation in itself since it seems to be inconsistent with important consumer concerns about quality and safety aspects.

What does the EU public care about most? In terms of its preferences for policy attention, does it care more about quality than quantity; or does it care more about safety or price? While there are no obvious data or indicators to measure the relative importance of these various issues for the EU public, one can get some insights from different pieces of evidence. In particular, we look at three: public surveys, political pressure, and media attention.

The first set of empirical evidence comes from the Eurobarometer survey results. While the survey results cannot answer these questions clearly, what emerges is that health and food safety concerns are very important to EU consumers. Consumers associate a variety of health and safety concerns with food. Most people worry about pesticide residues in fruits, vegetables or cereals. Concerns about new viruses like avian flu, residues in meat like antibiotics or hormones, unhygienic conditions in food handling outside the home (during processing and retailing) are the second most worrying issues to consumers.

The second set of empirical evidence looks specifically at the political pressure related to food policy issues. More specifically, we look at the issue when did price/quantity versus safety/quality issues cause major political problems for EU governments? If we look at what has happened in Western Europe with regard to food price and quantity issue, the last time that the fight between consumers and producers over prices lead to major government crises was just before and just after the second World War.[2] For example, in 1936 the Belgian government fell over a proposal to increase

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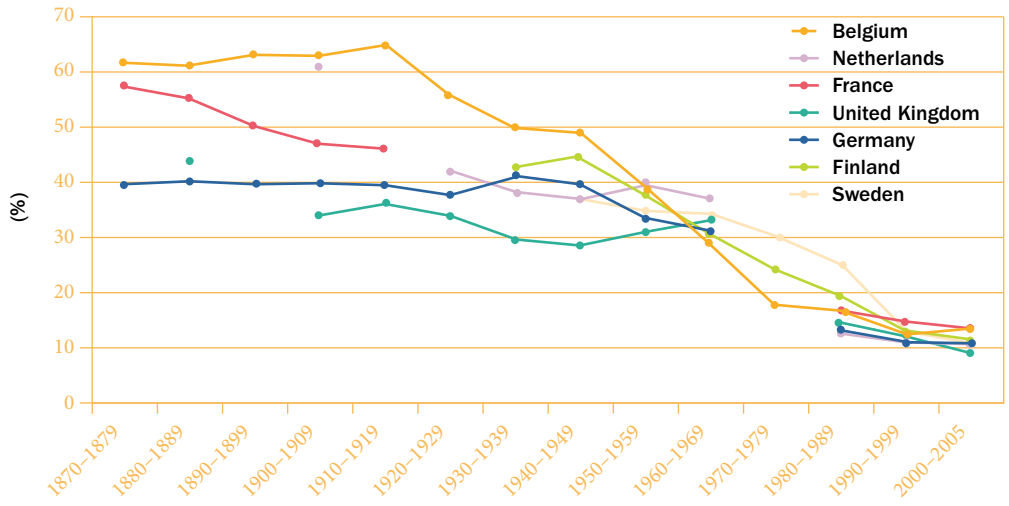
[2] See Swinnen (2009) for details.

Figure 1: Share of food in consumer expenditures



Source: Swinnen (2009)

grain import tariffs which was strongly opposed by workers, represented in government by the Socialist Party. From the 1950s onwards, price and quantity issues remained important issues, but mostly for producers, and never to the extent that they caused the collapse of governments—albeit that they played a very important role in international trade negotiations. In contrast, as recently as the 1990s, the political impacts of successive major food safety crises were considerable in several EU member states; in particular following the BSE, FMD and dioxine crises in the second half of the 1990s.[3]

The third set of empirical evidence refers to how the media covered the food crises. An interesting natural comparison is the media coverage of the late 1990s food (safety) crises with the current 2006-2008 food (price) crises.[4] Such comparative analysis yields the conclusion that price issues received important news coverage, but typically only in the inner pages and often in the economy sections of the newspapers. In contrast, the food safety and quality crises in the late 1990s were covered much more extensively, with much stronger statements and with major front cover articles.

In combination, these pieces of subjective evidence suggest that for the EU public safety and quality issues are at least as, and likely more important, than price or quantity issues from a policy perspective. The reason for this is most likely related to the decline in the share of food expenditure in Europe. Data from a hundred and fifty years for Western European economies shows that the share of food in consumers' expenditures has gone down tremendously. Consumer's income spent on food declined to its 10% levels in 2005 while one hundred year ago it was

[3] For example, in 1999 the governing parties in Belgium lost very heavily after the dioxine crisis. Studies made afterwards clearly indicated that the crisis had an important impact on this outcome.

[4] See Swinnen et al (2005) for details.

between 40% and 60%.[5] Moreover, the share of total food expenditures going to agricultural producers has declined even stronger, with increasing share going to processing and marketing.

These observations, of course, raise important policy issues regarding the optimal policy mix and policy attention to the various elements. Interestingly, the recent reforms of the CAP have to some extent taken these issues into account. For example, the 2003 Fischler Reforms of the CAP explicitly mentioned the importance of ensuring safe and high quality food (Swinnen 2008). However, much of the actual expenditures under the CAP still went to traditional objectives, i.e. market and income support, albeit that most support was decoupled from specific production activities, and subject to cross-compliance requirements (European Commission 2008).

We will now discuss food security, food safety, and food quality policy issues in turn.

Food security policy

Food security was a major issue in Western Europe in the post-World War II era, as the history of food shortages was still vivid. As such the formal objectives of the CAP still reflect this with its reference to ensuring an adequate food supply (European Commission 2007). However, although the objectives have not formally changed, it is clear that the issue became gradually less important in EU agricultural policy, even when price hikes in the early 1970s brought the issue back temporarily.

The dramatic food price increases in 2007 and 2008 have brought food security back to the policy table as an important issue. However, several issues need to be taken into consideration.

First, extensive research on food security issues globally, and particularly in developing countries, have made it clear that food security is mostly not a supply problem, but a demand problem.[6] Wars, violent conflicts, or disasters which destroy supply lines are an exception to this rule but even then demand constraints are important.

This shift in perspective is also reflected globally in changed definitions of food security used by international organizations.[7] The initial focus, reflecting the global food concerns of the early 1970s, was on the volume and stability of food supplies. Food security was defined in the 1974 World Food Summit as: *"availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices."* In 1983, FAO expanded its concept to include securing access by vulnerable people to available supplies, implying that attention should be balanced between the demand and supply side of the food security equation: *"ensuring that all people at all times have both physical and economic access to the basic food that they need."* By the mid-1990s food security was recognized as a significant concern, spanning a spectrum from the individual to the global level. However, access now involved sufficient food, indicating continuing concern with protein-energy malnutrition. But the definition was broadened to incorporate food safety and also nutritional balance, reflecting concerns about food

[5] However, a cautionary note needs to be bear in mind with regard to the enormous heterogeneity that exists across the current EU-27. For instance, the previous arguments can not easily be applied and generalized for Eastern European countries like Romania as it is for the rich north-west Europe. The issue of food price may also be more important in the income of especially poor, unemployed people and pensioners.

[6] This new emphasis on consumption, the demand side and the issues of access by vulnerable people to food, is most closely identified with the work of Noble Prize winner Amartya Sen. Eschewing the use of the concept of food security, he focuses on the entitlements of individuals and households.

[7] See FAO Food Security website for more details.

composition and minor nutrient requirements for an active and healthy life. Food preferences, socially or culturally determined, now became a consideration. The potentially high degree of context specificity implies that the concept had both lost its simplicity and was not itself a goal, but an intermediating set of actions that contribute to an active and healthy life. The 1996 World Food Summit adopted a still more complex definition: *"Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."*

While the international community has accepted these increasingly broad statements of common goals and implied responsibilities, its practical response has been to focus on narrower, simpler objectives around which to organize international and national public action. The declared primary objective in international development policy discourse is increasingly the reduction and elimination of poverty.

In this shifting perspective and emphasis on the demand side, the main food security problem in the EU relates mostly to those living in poverty, which is a small minority in richer EU countries, and a sizeable group in poorer EU countries. Possibly in size the most important group are older people, and in particular those living in rural areas, in some of the new EU member states which are living on very low pensions and who have to keep working at old ages to produce some food for their household food security.

In terms of policy solutions, the best approach is to address the fundamental problem, which is the low incomes of these people, e.g. by increasing their pensions.

Second, the current concerns of food security, based on the uncertainty whether future food supply can meet demand, are related to the high food prices in 2007 and the first part of 2008. To analyze the policy implications, we should first look at the causes of the high prices. Several studies have pointed out that the main reasons are a combination of structural, temporary, and policy factors.[8] This includes the growth in food demand with the growth in developing countries such as China and India—but also in Africa, the growth in agricultural commodity demand for bio-energy—in particular biofuels, declining productivity (yield) growth in richer countries, bad weather, export constraints imposed by exporting country governments, etc. Related to these factors, and indirect causes, are policies that have stimulated the growth of biofuels (subsidies and mandates), the high oil prices which affects both the costs of production and the (market) demand for bio-energy, and possibly climate change which affects weather conditions.

An important observation is that agricultural production, both in the EU and globally has responded positively to the high prices: production in 2008 has increased substantially over the past years.

What does all this imply for policy?

1. Climate change is the subject of a different conference session. I will limit myself to the comment that studies seem to show that climate change is likely to affect food production in different regions quite differently and that parts of the EU may be negatively affected and parts positively. The total impact of climate change on global agricultural production as well as on EU

[8] See various reports and studies by IFPRI, FAO, OECD and the World Bank.

agricultural production may be positive, but important reallocations appear likely.

2. An important policy issue is how to deal with bio-energy as a competing demand with food for agricultural commodities. The main food security policy here appears to be to stop stimulating bio-energy demand by removing subsidy and mandate policies.

3. Even without government support, demand for agricultural commodities for bio-energy purposes is likely to increase if oil prices recover in the coming years. Similarly, the growth in food and feed demand from countries like India and China is likely to continue despite the current financial and economic crises in the world economy. It is unclear whether productivity trends in rich countries will continue to face declining growth rates, or whether rapidly increasing productivity in developing countries can continue.

4. However, if the fundamental trends which we have outlined here continue, there appears to be an upward pressure on agricultural and food prices.

5. From a policy perspective this has important implications.[9]

   a. It means that agricultural market prices will increase in the future and that there are less arguments for governments to support farm incomes.

   b. The dramatic changes (both increases and decreases) in commodity and food markets over the past years has re-emphasized the importance of addressing risk and uncertainty for farmers and other agents active in agricultural and food markets. Policy initiatives and instruments that reduce such uncertainty, and the risk associated with it, would be important beneficial elements in the food production system.

   c. Given the daunting challenges to produce more agricultural commodities for food and non-food purposes, and the lagging productivity growth rates in the EU, there should be important policy support and investments in R&D and technology development and diffusion (a) to improve productivity of agricultural production and (b) to reduce the pressure of bio-energy on food prices.

   d. In this perspective, the EU should consider reallocating a substantial part of the CAP budget to stimulate green technologies to stimulate the rural/food/bio-economy.

   e. In this perspective, the issue whether biotechnology should be part of such EU policy for the future is an important policy question.

[9] These are in addition to potential consumer policies, such as advising a less meat-intensive diet.

Food safety policy

Until very recently, food safety policy was mainly a member state's responsibility, except for some veterinary directives from the European Commission. The food safety crises in the 1990s, particularly the BSE crisis in 1996 and the dioxin crisis in 1998, were crucial in changing this. In 1997, almost a year after the BSE crisis, the Commission launched a new food safety initiative which resulted in the publication of its 'White Paper on Food Safety' in 2000 (European Commission 2000). This led to major legislative changes and to the *Basic Food Law Regulation,* including a recast of EU veterinary rules, and the creation of the European Food Safety Authority (EFSA).

The main goal of this EU food safety policy is protecting consumer health while ensuring

smooth operation of the 'single market' and taking into account existing or planned international agreements on standards (like the Sanitary and Phytosanitary (SPS) and technical barriers to trade (TBT) agreements (OJEC 2002).

The food safety policy follows an integrated *'from farm to fork'* approach since the year 2000. Unlike many other approaches which target controlling food safety standards at end products in the supply chain, this approach tries to control risk in all stages of food production and distribution. The EU's Rapid Alert Systems for Food and Feed (RASFF) entered into force in 2002.[10] RASFF uses traceability as a tool to ensure efficient risk management and quality control.

The EU has also adopted specific sector rules on products of animal origin intended for human consumption (Regulation (EC) Nº 854/2004). This act covers fresh meat, fish, milk, dairy, poultry etc… while Commission Decisions 2006/766/EC and 2006/696/EC and subsequent amendments specify the list of non-EU countries from which imports of these products are allowed. In addition, official controls on good hygiene rules of HACCAP principles and on maximum residue level (MRL) are in practice;[11] as do specific rules on the use of pesticides; food supplements; colorings; antibiotics and hormones in food production; additions of vitamins; minerals and similar substances in food; products in contact with food stuffs-such as packaging.

Key policy issues for the future are:

1. whether the system as it has recently been designed and implemented is sufficient and efficient in addressing public concerns related to food safety;
2. whether current and future 'agricultural policies' are consistent with the food safety rules and policies;
3. whether there is a need to adjust these policies in the light of rapidly growing private standards (see further);
4. whether there is a need to adjust these policies in the perspective of trade agreements and trade developments (see further).

Food quality policy

While there is both in theory and in practice an important relation between safety and quality, one can identify several product characteristics which consumers may appreciate (color, size, production process (no child labor, …), …) but which are not safety characteristics.

There is no real EU quality policy at this moment although the European Commission is preparing proposals for such a policy. Thus far, there is some support for EU quality production under the CAP Pillar II (Rural Development Programs) where some of the programs are explicitly linked to upgrading quality or producing quality.

Even at the member state level, most of the quality policy initiatives are recent. Unlike before, where food quality was almost only a private sector initiative, now governments are getting involved

[10] The RASFF system covers all foodstuffs and feed. It is comprised of a network of all member states, the commission and EFSA as a member. There has been an existing early warning system in place both at the member states and the Commission but the new system extended more to include both food and feed under the umbrella of the 'farm to fork' strategy. Therefore, the network jointly acts to spot unsafe food and feed. If a threat is spotted, an EU-wide notification system acts depending on the level of risk detected. Rules related to emergency, risk management measures during food scare cases and scientific uncertainties are all part food law (DG SANCO, 2007). For more details see OJEC (2002, L31/1)

[11] The Codex has established MRLs in line with Good Agricultural Practices (GAP). Therefore, national and EU MRL standards are assessed against Codex as a reference point which sets science as its primary drive to assess risk.

in food quality schemes and are setting up the public–private partnerships initiatives.

For example, Germany has developed its QS (Qualitätssicherung) system, which is one of the most elaborate initiatives at the member state level. It is a recent initiative (2002–2005) and has different types of schemes at all levels of the food chain (feed industry, the meat industry, processing, retailing, and marketing). The products included are pork, beef, veal, poultry—all started in 2002; while fruits, vegetables, potatoes and combinable crops started in 2004 and 2005 respectively. Looking into the essential characteristics of this QS system, it is striking that although the systems name refers to "quality assurance," many of the controls and assurances relate to safety features, including tracability, internal control and transparency.

Key policy issues for the future are:

1. Whether there is a need for an EU level food quality system, or to leave this at the member state level;
2. Whether to increase funding for local initiatives under the Pillar II;
3. Whether current and future EU-level 'agricultural policies' are consistent with food quality objectives and initiatives;
4. Whether there is a need to make adjustments in light of rapidly growing private standards (see further).

Private versus public standards

There has been a rapid growth in private sector initiatives in the field of food safety and quality standards. The most important—and most far reaching—is undoubtedly the GlobalGAP standard (formerly EurepGAP) which is now used by all main retailers in the EU.

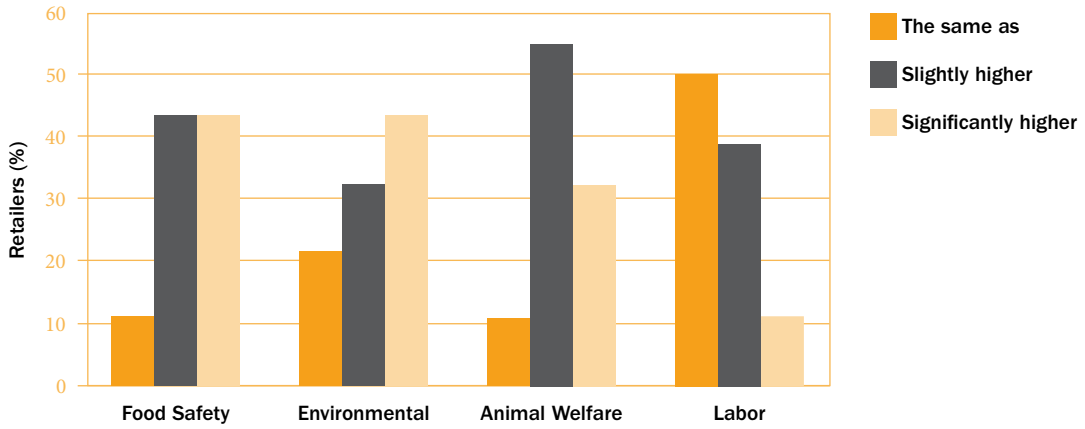
There is an interesting dynamic between public and private standards. Private standards may be introduced because public standards are insufficiently stringent (or absent)—in this way they may either be introduced earlier than public standards, or may follow after public standards are introduced. Private standards may also be introduced as a marketing tool, to reduce transaction costs in business dealings, to reduce information imperfections of consumers, etc.

In a number of areas, private standards are more restrictive than public standards. Fulponi (2007) interviewed EU retailers and asked them to assess their own standards compared to those in government standards. Under the four categories (food safety, environment, animal welfare and labor), public standards are found to be mostly important only in social and labor standards; but in all other cases the private standards are more important than the public standards.

With respect to trade issues, public regulations require equivalence of risk outcome. It is essentially based on the evaluation of the final product which is consistent with the SPS agreement of WTO. In contrast, private systems may be more demanding. GlobalGAP for example requires equivalence of systems based as well on the evaluation of the process which requires tractability of the product, not requested by public standards. Therefore the private sector requirements on imports are more demanding.

Finally, the relative importance of public and private standards varies strongly. In a comparison of standard setting institutions among countries, Henson (2004) shows that private and public-private initiative standards are much more important in developed countries than developing

Figure 2: Retailers self-assessed standards compared to those of government



Source: Fulponi, 2007

countries. In developing countries 88% of standard setting institutions are public rather than private—which is an interesting observation given the problems of enforcement which are characteristic of these countries.

Key policy issues for the future are:

1. Whether there is a need to make adjustments (introduce/tighten/relax/remove) of public standards in the light of rapidly growing private standards.

EU food safety & quality policies/standards: Barriers or catalysts to trade?

To what extent are EU food safety and quality policies barriers or catalysts to trade? The traditional argument in the international trade literature and discussion is that safety and quality policies are barriers to trade—i.e. they constrain trade by introducing complications and hurdles. In an environment where traditional trade protection instruments, such as tariffs and quotas, are increasingly regulated they are mostly considered alternatives for protection under the form of non-tariff barriers (eg Anderson et al 2004; Fischer and Serra 2000, Lapan and Moschini 2004; Sturm 2006).

In addition, it is generally argued that increasingly demanding EU food standards (both public and private) are hurting developing countries since they are unable to address these standards. Moreover, in case they can it is argued that it is mostly multinational companies or large producers who may benefit but that small and poor local producers are either marginalized or exploited in this process (eg. Dolan and Humphrey 2000; Farina and Reardon 2000).

However, new empirical evidence and theoretical arguments question the validity of these arguments in all circumstances.

First, compliance costs for countries may be lower than often thought. World Bank estimates for compliance costs are relatively low, in the range of 4–8% but not 20–30% as it has often been presumed (Aloui and Kenny 2005; Cato et al 2005).

Second, standards can also be "catalysts" for trade by reducing transaction costs. That is an important reason why the private sector uses standards—

precisely to reduce transaction cost. This reasoning should also be taken into account when we evaluate public standards. Also consumers want standards because they provide information and reduce transaction cost. It is crucial, when analyzing the effect of standards in an international economic framework, to look at both benefits and costs to both consumers and producers. Consumers may benefit because of reduced asymmetric information (or externalities) while cost increases presumably affect them negatively. Producers face increased cost because of compliance while they may benefit due to increased demand if they can reduce the asymmetry problem. There may be additional environmental effects that affect the rest of the society.

Taking this into account, Swinnen and Vandemoortele (2008) show that one may either have 'over-standardization' or 'under-standardization'. Almost any standard causes trade distortion. However, it can either create more trade or it can reduce it. In fact, standards can be at the same time catalysts and barriers. Standards may affect comparative advantage through reinforcing (or weakening) scale economies, through differences in implementation costs, or in enforcement of standards. These factors may differ substantially among countries (Swinnen and Vandemoortele 2009).

Third, new evidence from trade between Africa and the EU shows that standards can have major effects on the organization of the supply chains and in particular on how local suppliers are integrated or not. Typically increased standards induce consolidation and vertical coordination in the chain. However, our studies on Africa also show that poor rural households may benefit substantially from these export systems, either as contract farmer or through the labor market (Maertens and Swinnen 2008; Maertens and Swinnen 2009; Minten et al 2009). In summary, EU food standards may be protectionist instruments, but not necessarily. This implies some difficult issues for analysts, trade negotiators, and policy-makers alike:

- Unlike tariffs, socially optimal standards are often not zero. Moreover, they may be different for rich country compared to poor country because consumer preferences are different in these countries. So how to separate protectionist standards from social welfare improving standards?
- An increasing share of the standards which affect trade are private standards. How can/ should these standards be dealt with in international institutions dealing with trade disputes (WTO)?

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Agriculture and Structural Adjustment

Catherine Moreddu[1]

Introduction

The European Union has been engaged in long-term reform of its common agricultural policy (CAP) since 1992 with the objective to increase the market orientation of the sector. This would be achieved by reducing protection and increasing the level of the sector's exposure to world markets while decreasing those supports that alter production and trade the most (OECD, 2008a). This latter shift, designed to reduce the link between public support and production, is known as decoupling.[2] This reform results from internal considerations on improving economic efficiency and better use of public funds, as well as external considerations such as international trade negotiations.

CAP reform continues today along the same orientation. It is gradual and progress depends on the period, subject and sector under consideration. The greatest progress has been made in reducing the most distortive forms of support, whereas reductions in support levels has been less significant. Over the last years, there has been more progress in decoupling policies than in reducing the levels of protection or towards targeting aid to specific objectives.

This study is based on work undertaken by the OECD Trade and Agriculture Directorate.[3] Since the mid 1980s, the OECD has monitored the evolution of agricultural policies in member states and in some emerging countries, and assesses these according to their economic efficiency and equity. The evaluations are based on economic analyses and offer countries the means to compare their experiences. Recommendations are put forward in terms of means to fulfil policy objectives in cost-efficient ways. In addition to studies on policy evaluations in general (targeting: OCDE, 2007c; decoupling: OCDE, 2006a), or by country,[4] the OECD has recently undertaken studies on reform adjustment policies (OCDE, 2006b) and on related topics such as compensation (OCDE, 2007a) and farmers' income diversification (OCDE, 2009). In so far as developing countries are concerned, a study on small farm adjustment was presented at the Global Forum on Agriculture in November 2008 (OCDE, 2008c).

It is essential for policy evaluations that their external effects and results be analyzed according to their objectives. The original aim of CAP (article 33 of Rome Treaty) was to 1) increase productivity; 2) ensure a fair standard of living to farmers; 3) stabilise markets; 4) guarantee stable supplies; and 5) ensure reasonable prices to consumers. These objectives are still enforced, but others related to the environmental sustainability of the sector and the viability of rural zones, have become important as well. And rather than placing emphasis on ensuring sufficient quantities of foodstuffs, the emphasis today is centred on ensuring food safety and quality.

If structural adjustment is not clearly mentioned in policy objectives, it is implicit in the objectives set for productivity and income that are aimed at ensuring the sustainability of the agricultural sector. However, the importance accorded to adjustment

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[2] This issue was studied theoretically and empirically in a series of OECD studies which are summarized in OECD (2006a). See: http://www.oecd.org/document/47/0,3343, en_2649_33777_25110575_1_1_1_37401,00.html

[3] This article is based on various OECD studies but reflects the view of its author only.

[4] OECD publishes not only annual reports on the policies follow up and assessment in OECD member countries and in emerging countries, but also more in-depth studies by country. The most recent study deals with Japan and Chile. A study on CAP evolution since 1992 is to be undertaken.

by country depends on the level of adjustment this country has reached, although in general it has become more prominent since EU enlargement to countries with specific adjustment problems.

This article outlines what is meant by structural adjustment and lists the conditions where public intervention is conceivable at the economic level. It then gives a few examples of current structural policies and their evaluation in OECD studies. Finally, it summarises recommendations on how to implement efficient policies that attain their objectives at the least cost.

What is structural adjustment?

Policymakers distribute resources among sectors and individuals within a sector. Structural adjustment is the evolution of this distribution according to:

- Changes in economic trends or;
- Sudden changes due to policy reforms or a crisis situation.

Table 1. Pace of adjustment in various countries, based on agriculture share of GDP and employment

	Agriculture share of GDP			Agriculture share of employment		
	Year of 40%	Year of 7%	Years required	Year of 40%	Year of 16%	Years required
Netherlands	1800	1965	165	1855	1957	102
Denmark	1850	1969	119	1920	1962	42
United Kingdom	1788	1901	113	1800	1868	68
Chile	1875	1980	105	1950	1993	43
Mexico	1890	1992	102	1969	2000	31
USA	1854	1950	96	1897	1950	53
France	1878	1972	94	1921	1965	44
Brazil	1910	2003	93	1960	2005 (20.5%)	>45
Germany	1866	1958	92	1900	1942	42
Japan	1896	1969	73	1940	1971	31
Poland	1935	1991	56	1968	2006 (18.7%)	>31
India	1962	2006 (17.5%)	>44		2005 (58%)	–
China	1967	2006 (11.7%)	>39		2006 (43%)	–
Turkey	1970	2007 (8.9%)	>37	1998	2007 (28.7%)	>9
Korea	1965	1991	26	1977	1991	14
Indonesia	1971	1997	26		2006 (42%)	–
Russia		1992 –		1961	1991	30
South Africa		1970 –		1950	1980	30

Source: Adapted from Kim, H. and Lee, Y.K. (2003).

Adjustment is required to maintain maximum growth and welfare. In the agricultural sector, adjustment should ensure long-term viability in a sector where many of its multiple objectives are relevant for society and in which public intervention is frequent.

Trends that are prevalent in the agricultural sector act on the supply side, on increases in productivity linked to technical innovations which significantly reduce labour inputs, as well as on the increase in international competition due to reduced transportation costs and levels of protection. On the demand side, we note an increase in demand by emerging countries that follows the increase in their population and income, as well as demand segmentation towards more diversified products that are of a higher quality, of higher added value or more environment-friendly. As the increase in production was higher than consumption, there was a trend towards lower prices. This resulted in an adjustment trend that saw a decrease of the share of agriculture in the overall economy, a decrease in the number of farms and an increase in their average size, although the decrease in agricultural land was a less significant factor than the role of others in this sector.

In OECD countries, trend adjustment started long ago and is well advanced in most member countries. The share of agriculture in the economy is, on average, less than 2% of the GDP and less than 6% for employment (OCDE, 2009). In the 15 members belonging to the European Union, these shares were respectively of 1.8% and 3.6% in 2005 (2.8% and 3.5% in France). In developing countries, the trend adjustment began later and is progressing more rapidly today (OCDE, 2008c). As shown in Table 1, it took more than a century for the United Kingdom to lower its agricultural share of GDP from 40% to 7%, and only 26 years for Korea and Indonesia.

Adjusting to externalities is a growing concern for policymakers in OECD countries. These concerns include policy reforms, strengthening health and environmental regulations, responding to rapid shifts in demand (due to panic; trend changes in, for example, calorie intake, sweets and fats), sudden increases in production costs (energy), and sanitary crises.

Pressures on the sector have led to an increase in the average farm size (Table 2) but also to various adaptation strategies that have led to greater diversification. Without going into too much detail, while some farms adapt by increasing their land size in order to benefit from economies of scale and higher productivity of the workforce and of the capital, others prefer to target improved quality, to increase added value, or to diversify their activities within and outside the agricultural sector. Farm diversification mainly consists in direct retailing, increased added value on the farm, contractual work on other farms, as well as forestry, ecotourism, or the production of renewable energy. Diversification of income sources outside the farm brings significant complements to the household income. These sources are primarily derived from salaries, followed by welfare benefits. In some countries, such as the United Kingdom, capital income is important (OECD, 2009). There is also an increasing number of farms that are not commercial operations, but rather exist as a choice of lifestyle (hobby, retirement).

Why Intervene?

At the economic level, public intervention is based on two types of concerns: economic efficiency and equity (OCDE, 2002).

Table 2. Shift of average farm sizes in OECD countries in the last decade

	Number of holdings			Utilised agricultural area			Average size			Agricultural employment		
	(1000)		%	(1000) hectares		%	Hectares		%	(1000)		%
	1995	2005	change	1995	2005	change	1995	2005	change	1995	2005	change
Australia	147	130	-12	463,349	445,150	-4	3,150	3,426	9	419	356	-15
Austria	219	171	-22	3,425	3,266	-5	16	19	23	278	211	-24
Belgium	62	52	-16	1,368	1,386	1	22	27	21	109	84	-23
Canada	277	229	-17	68,055	67,587	-1	246	295	20	537	435	-19
Czech Rep.	82	42	-49	4,281	3,558	-17	52	84	61	328	195	-41
Denmark	69	48	-30	2,726	2,590	-5	40	54	35	108	86	-20
Finland	101	71	-30	2,259	2,264	0	22	32	43	162	122	-25
France	735	545	-26	28,267	27,470	-3	38	50	31	998	864	-13
Germany	567	390	-31	17,344	17,035	-2	31	44	43	1,079	850	-21
Greece	801	834	4	3,578	3,984	11	4	5	7	749	554	-26
Hungary	967	715	-26	4,555	4,267	-6	5	6	27	295	189	-36
Iceland	n.d.	4	n.d.	n.d.	2,281	n.d.	n.d.	570	n.d.	7	6	-15
Ireland	154	133	-14	4,389	4,219	-4	29	32	12	136	116	-15
Italy	2,478	1,729	-30	14,685	12,359	-16	6	7	21	1,327	999	-25
Japan	2,651	1,963	-26	5,038	4,672	-7	2	2	25	3,674	3,174	-14
South Korea	1,501	1,273	-15	2,197	1,921	-13	1	2	3	1,596	1,329	-17
Luxemburg	3	2	-23	127	129	2	40	53	32	4	5	25
Mexico	4,074	2,700	-34	107,200	107,500	0	26	40	51	6,516	5,945	-9
Netherlands	113	82	-28	1,969	1,958	-1	17	24	37	232	214	-8
New Zealand	66	66	0	12,591	11,744	-7	191	178	-7	137	130	-6
Norway	71	53	-25	1,038	1,033	-1	15	19	33	84	64	-24
Poland	2,808	2,477	-12	17,274	14,755	-15	6	6	-3	3,834	2,314	-40
Portugal	451	324	-28	3,924	3,680	-6	9	11	30	547	606	11
Slovak Rep.	78	68	-12	2,446	1,880	-23	31	27	-12	189	92	-51
Spain	1,270	1,079	-15	25,230	24,855	-1	20	23	16	1,072	1,003	-6
Sweden	89	76	-15	3,270	3,192	-2	37	42	14	112	96	-14
Switzerland	79	64	-20	1,083	1,065	-2	14	17	23	225	181	-20
Turkey	4,068	3,077	-24	17,661	18,435	4	4	6	38	9,080	7,398	-19
United Kingdom	235	287	22	16,447	15,955	-3	70	56	-21	560	445	-21
United States	2,238	2,133	-5	384,796	379,708	-1	172	178	4	3,106	2,913	-6
EU15	7,346	5,821	-21	129,009	124,342	-4	18	21	22	7,473	6,253	-16
EU19	11,281	9,123	-19	157,566	148,800	-6	14	16	17	12,119	9,043	-25
OECD	26,454	20,815	-21	1,220,573	1,189,895	-3	46	57	24	36,999	30,972	-16

n.d.: n/a.
Source: OECD (2009).

Efficiency concerns

Countries intervene to:

- Correct market failures (land, capital, workforce) which, if not adjusted, would lead to a suboptimum resource allocation;
- Limit short- to medium-term adjustment costs.

The intervention should therefore be conditioned in the first case by evidence of market failure and, in the second case, by a cost-benefit analysis of the entire rural economy sector.

Equity concerns

In terms of equity, this usually entails:

- Monitoring adjustment and compensate in part sudden drops in income or asset values;
- Ensuring that inequalities in incomes and assets are not increased.

It should be noted that in terms of distribution, although farm consolidation increases income inequality within the sector, it reduces inequalities between sectors given that there is an increase in the efficiency of the sector.

It should also be noted that the majority of countries which intervene to facilitate adjustment actually slow this process down, which explains the longevity of certain adjustment policies.

What interventions today?

Positions vary from one country to another, some being clear-cut, and adjustments have different objectives depending on whether they are meant to accompany (curb or encourage) the trend or react to a given shift.

On the one hand, there are countries such as Australia, where the optimum structure is determined by the market while giving farmers the means to adapt, for example by giving them access to risk management tools (insurances, futures markets, transitional support mechanism in case of disaster).

On the other hand, other countries favour more general interventions with heavy constraints on land use, e.g. Japan or Korea. Some countries intervene to influence the structures' results. This is the case for France, with SAFER, but also for emerging countries or those in transition that undertook land reform (privatisation, the dismantling of large farms). The goal of an agriculture oriented towards medium size family-run farms is widespread in Europe. Some countries such as France seek to maintain the current number of farmers. The question is how to best determine the optimal farm structure outside any consideration of market mechanisms. Opinions also differ as to the widespread strategy of diversification of activities. This diversification is at once encouraged by types of support but also curbed by regulations which favour farming activities (OECD, 2009).

Between these two, there exists a broad range of supports for investment in agriculture and in farm diversification activities to aid in the conversion of farm activities (for example, taking out vineyards, buying back quotas), for conversion or early retirement, as well as counselling, rural extension, diagnosis help, or restructuring (development plans). These measures are sometimes permanent, but they may also be temporary to limit adjustment consequences (social and economic costs) of a policy reform. In addition to the measures listed above, there are compensations for asset value losses and limited targeted decoupled income aids. Some examples of adjustment measures to a reform were assessed in an OECD study (2006b): the grain transportation reform in Western Canada (Box 1) and the milk sector reform in Australia (Box 2). Within this framework, early retirement

Box 1. Western grain transportation reform in Canada

The Western grain transportation reform in Canada, implemented in 1995, consisted in the repeal of the Western Grain Transportation Act (WGTA) that eliminated payment of the Crow benefit to the railways for the movement of prairie grain towards ports and the amendment of the Canada Wheat Board (CWB) Act to change the price-pooling regime for prairie grains so that prices reflected real transportation costs. In order to assist the affected areas, the government implemented the Western Grain Transition Payments Program (WGTPP) to compensate landowners for the loss of the subsidy and the Western Grain Transportation Adjustment Fund to help industry adapt to the changes.

The WGTPP sought to compensate for the drop in land values that was expected to result from the elimination of the WGTA. This transition programme distributed a one-time capital payment of CAD 1.6 billion to landowners in Alberta, Saskatchewan, Manitoba and part of British Columbia. WGTPP was to be paid out in two instalments. Approximately 75% of the payments had been paid out by the summer of 1996 and the remainder in the fall of 1996. The payment was based on a formula that considered number of acres, the productivity of the soil, whether or not the land was irrigated and the distance of the land from the nearest port (the closer of Vancouver or Thunder Bay).

Experience has shown that agriculture is a dynamic industry and that reform of policy can generate new challenges and opportunities. When these subsidies were removed, farmers and others in the industry responded quickly to market signals through a diversification of crop patterns, an increase in livestock production, and investments in value-added processing.

Source: Extracts from OECD (2006b).

programs for farmers and installation aid schemes in Ireland have also been assessed (Box 4).

At the European Union level, adjustment measures concern both permanent schemes that countries may include or not in their national (or regional) rural development programs (RDP)[5] and specific reform targeted schemes (or at least additional financing).

The restructuring of the sugar industry constitutes a recent example of reform adjustment. The Common Market Organisation (CMO) reform of the sugar industry, implemented in 2006, reduced guaranteed prices, eliminated the intervention system, and modified the quota system. It granted partial compensation to sugar beet growers, amounting to about 60% of the estimated income loss as an annual payment to be integrated into the annual single payment of the 2003 reform. The reform also sought to implement a voluntary restructuring scheme in return for the availability of funds for factory closures, compensation to sugar beet growers, for diversification measures in regions of member states affected by the reforms, and for transition measures (European Union Commission, press release IP/05/1473, 24 November 2005).

"Permanent" measures are financed by national or regional RDPs. Both deal with investment support to modernize farms, to help young farmers begin their activities, to adapt to new standards, improve

[5] These are the schemes that define the implementation of the rural development regulation (RDR), also know as CAP 2nd pillar.

Box 2. Australia dairy industry adjustment policy

In 2000, manufacturing milk price support (the DMS scheme) terminated along with all fluid milk applicable regulations. Simultaneously, the government announced implementation of a three component AUD 1.78 billion restructuring packaging:

- The Dairy Structural Adjustment Program (DSAP) for all dairy producers,
- A Dairy Exit Program (DEP) to assist farmers exiting the industry; and
- The Dairy Regional Adjustment Program (DRAP) to manage the flow-on effects for regional dairy communities.

The restructuring grants had two payment components of 46.23 Australia cents per liter for fluid milk and around 8.96 Australian cents per liter for manufacturing milk. This ensured DSAP assistance was targeted according to the loss of support under each policy arrangement.

DEP was a 'safety-net' assistance program designed to assist farmers in serious financial difficulty. It was open to applications for two years and successful applicants had to cancel their DSAP entitlements. Acceptance of a DEP grant required producers to sell their dairy farm and withdraw from agricultural production for five years.

DRAP objective was to create employment opportunities in dairy dependent communities that were adversely affected by deregulation. There were concerns about the regional economy effects of lower farm incomes, farmer retirements and plant closures. The program was designed to supplement local business investment initiatives. Individuals or groups could apply for grants to help establish alternative activities. Some dairy companies obtained grants to support plant redevelopments and other business activities. DRAP funds were also used to support infrastructure projects, retraining initiatives and counselling services in badly affected regions.

The effects of the reform were harsher than expected and additional funds were poured into the DRAP and DSAP schemes in the end of 2000.

One of the main features of deregulation of the Australian dairy industry was removal of all price support measures over-night. It caused an immediate, substantial decline in average returns. In the lead-up to deregulation farmers were unsure about the nature and implications of the reform. Producers had 9 months warning after the decision was announced to consider their situation and make on-farm adjustments. The industry has adjusted rapidly to the effects of deregulation. The adjustment package has helped producers to make the transition. In addition, world prices for dairy products were high which considerably helped the transition by increasing export returns.

The adjustment response of most interest is the reaction of producers who specialised in fluid milk sales. Some have retired from the industry. Those who remained in the industry experienced a substantial drop in average returns. These producers have made adjustments to their farming operations to off-set the decline in farm income. One of the features of this assistance package was that it includes both support to the producers to exit from the sector and to stay in the sector. The adjustment

continued

Box 2. Australia dairy industry adjustment policy (Continued)

assistance helped those who decided to leave the sector but also helped to improve the viability of those farm enterprises that decided to remain in the sector. In general, producers reacted by increasing farm output. Farmers expanded their milking herds and in some cases increased land area. Changes in secondary input use improved the productive performance of the primary inputs. Carrying capacity increased through greater use of improved pastures, fertilizer and water inputs. Pasture management improved and livestock productivity (milk yields) gains have come from more supplementary feeding.

Source: Extracts from OECD (2006b).

quality and innovation in agribusiness, and to aid professional training including changing professions, counselling, producers' organisations, and early retirement (see Box 4 for early retirement from farming and Installation Aid Schemes in Ireland). Specific transitional measures to subsistence farms and aid for the creation of producer groups are available to the countries that joined the EU in 2004.

Most of these adjustment measures are included in Axis I of the RDR measures to improve the competitiveness of the agricultural and forestry sectors (Box 3). Some measures, such as those aimed at modernising agricultural holdings, setting up young farmers or early retirement, have been implemented for many years at the community and national levels. They were originally called "structural measures" (not to be mistaken with regional or structural funds which are not specific to agriculture), but in 1992 were included in the so-called accompanying measures that later became part of the 2000-06 programme, then in the 2007-13 programme of the RDR.

Two other axes concern rural development and environment improvement (axis 2), and rural economic diversification and living standards in rural zones (axis 3). The regulation allocates a minimum of 10% of RER funds for Axis 1 and 2, and 25% for Axis 3.

When looking at the share of Axis 1 in the PDR 2007-13 expenses, significant differences appear between EU countries (Figure 1). Generally, the 10% lower limit is greatly exceeded. In five countries, the share is under 20%; in five others, it ranges between 20 and 30%. France belongs to the eight countries that grant between 30 and 40% of its PDR funds to Axis 1 measures. Among the nine countries that grant over 40% of the funds to Axis 1 are new member states, but also Greece, Portugal, and Belgium where this share exceeds 60%.

Aid measures to diversification are found in Axis 3. In the previous RDP, these shares were variable, the amount varying by country (Figure 2).

How can policies be improved?

The various policy evaluations made by OECD have led to recommendations for optimal policies to reach most efficiently the set objectives with minimal costs and production and trade distortions. OECD (2002 and 2008b) summarise many of these studies' conclusions. This section will first outline what good practices are and what must be done to establish such policies. It will then propose specific recommendations to adjustment policies.

General recommendations for optimal policies

The principles in favour of agricultural policy reform, as stated in 1988 by the Ministers of Agriculture of OECD Member states, are:

Box 3. Measures included in Axis 1 for the improvement of the competitiveness of the agricultural and forestry sector

Measures support targeting the competitiveness of the agricultural and forestry sector shall concern:

a) Measures aimed at promoting knowledge and improving human potential through:

i) vocational training and information actions, including diffusion of scientific knowledge and innovative practises, for persons engaged in the agricultural, food and forestry sectors,

ii) setting up of young farmers,

iii) early retirement of farmers and farm workers,

iv) use of advisory services by farmers and forest holders,

v) setting up of farm management, farm relief and farm advisory services, as well as of forestry advisory services;

b) Measures aimed at restructuring and developing physical potential and promoting innovation through:

i) modernization of agricultural holdings

ii) improving the economic value of forests;

iii) adding value to agricultural and forestry products;

(iv) cooperation for development of new products, processes and technologies in the agriculture and food sector and in the forestry sector;

(v) improving and developing infrastructure related to the development and adaptation of agriculture and forestry;

(vi) restoring agricultural production potential damaged by natural disasters and introducing appropriate prevention actions;

c) Measures aimed at improving the quality of agricultural production and products by:

i) helping farmers to adapt to demanding standards based on Community legislation,

ii) supporting farmers who participate in food quality schemes,

iii) supporting producer groups for information and promotion activities for products under food quality schemes;

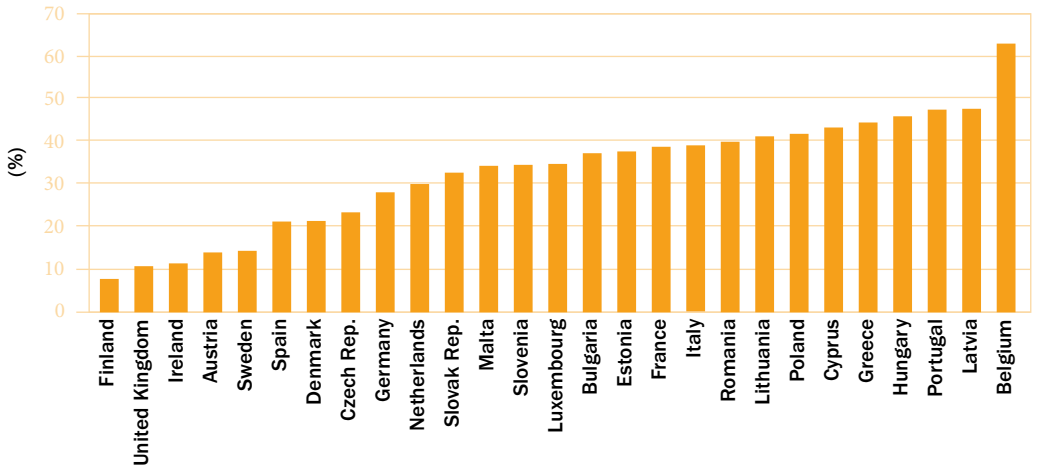
d) Transitional measures for the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia concerning:

i) supporting semi-subsistence agricultural holdings undergoing restructuring,

ii) supporting setting up of producer groups.

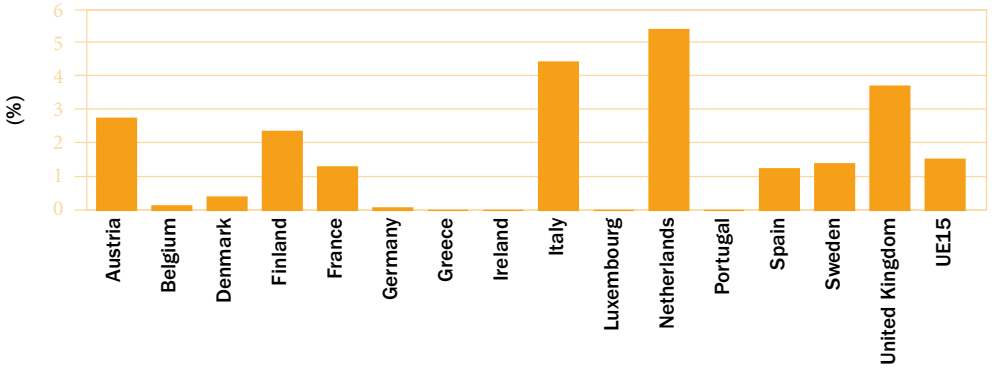
Source: Article 20 of Council Regulation (EC) No 1698/2005.

Figure 1. Share of axis 1 dedicated to competitiveness improvement in forestry and agricultural sector in the 2007-2013 RDP funds



See Box 1 for a list of measures included in Axis 1.
Source: Agra Informa Ltd, Rural Europe, July 2008. European commission website.

Figure 2. Share dedicated to diversification aids in total PDR funds, 2006



Source: OECD (2009), Table 10.1.

Box 4. The early retirement from farming and Installation Aid Schemes in Ireland

The overall objective of the ERS is to provide an income for older farmers who decided to stop farming and the aim is for them to be replaced by farmers who are able to improve the economic viability of their holdings. The average pension for the period to 31 December 2002 was EUR 12 750 compared to an average of EUR 10 794 for the period 1994–99. The adequacy of the amount of the pension is a key element in assessing the effectiveness of the ERS and the absence of indexation is a major weakness in the measure. It seems that this is one of the reasons for low uptake. At the national level the low uptake and pronounced regional imbalance in uptake does suggest that the impact of the measure as national level will be less than envisaged.

Even without incentives a certain number of farmers will give up farming and pass their farm over to an immediate family member. The question of to what degree this program accelerates the retirement process is difficult to assess and in the absence of a special survey there is no definitive data available to answer this question. It is likely that the measure is financing some transfers that would otherwise have occurred. Nevertheless, it is true that, to some extent, this program has accelerated the retirement process and has facilitated structural adjustment.

The Department of Agriculture and Food of Ireland has published an Expenditure Review of the Early Retirement Scheme, which has concluded that "recent studies have shown that the Scheme has had little effect on the structure of Irish agriculture". If this is the case, a thorough review of the scheme would be warranted.

The Installation Aid scheme has four specific objectives: To encourage young people to take up a career in farming; To ensure that such young people reach a high standard of agricultural education within a reasonable period following the date of set-up; To defray the set-up costs of eligible applicants setting up in farming for the first time during the period of operation of the Scheme; To make provision, in certain limited cases, for an element of working capital for farmers who are eligible to participate in the Scheme. The scheme provides a flat one-off premium of EUR 9 525 and is open to both full-time and part-time farmers. There is undoubtedly a large deadweight element, as many and probably most, of the recipients of the aid would take over the farm in any event. The level of the payment is probably not sufficient to be a key factor in determining whether a person would or would not enter farming. A main contribution of the scheme appears to be that it encourages participation in education by people who will take over farms. A simpler way to achieve this goal would be to simply pay farmers a grant on the completion of an educational course.

Increased participation in agricultural education should certainly increase the quality of the labour and management resource on farms. There may also be an issue of integration and consistency between these programs, as one favours exit from the sector and the other is implemented to attract labour into it. These two schemes could complement each other in the sense that both schemes aim to increase the number of young farmers in the sector. However they are separately

continued

Box 4. The early retirement from farming and Installation Aid Schemes in Ireland (Continued)

managed and there are separate conditions for eligibility, such as the definition of what constitutes a 'young' farmer.

Furthermore, it seems that there is a possible inconsistency between the objectives of the two programs—one designed to remove labour from agriculture in order to improve economic viability for those who remain in the sector by, in the case of Ireland, increasing the farm size and the other, designed to attract labour into the sector. They should, therefore, be more closely integrated both in terms of their objectives and of scheme terms and conditions.

Source: Extracts from OECD (2006b).

transparency of objectives, costs, advantages and identification of winners and losers of reforms; aid targeting of specific objectives, production decoupling, adaptation of efforts to targeted results, flexibility and equity.

The following recommendations concern all stages of defining policies and their implementation process.

Establishing objectives

A market failure that would justify public intervention must be identified and objectives must be established according to the situation and to the demands of society.

Consider all possible solutions, including non-intervention

We should first consider how the functioning of the market can be improved, for example by competition policies or by improvements to the market infrastructure. It is also necessary to consider whether the problem falls within the domain of agricultural policy or if other non sectoral actions are wiser, such as social or tax measures in the case of low income problems.

Establishing target variables

If an agricultural measure is deemed necessary to reach a specific goal, the choice of target variables (level of intervention) is an essential step. There are several dimensions to targeting:

- Eligibility criteria that define potential beneficiaries, such as young farmers;
- Geographical area, such as less favoured areas; and
- Targeted results, ideally defined in measurable terms, at quantitative and qualitative levels.

The relevance and the precision of targeting depend mainly on the scale of the problem and on transaction costs (OCDE, 2007b).

To implement a targeted measure on an adjustment objective, such as improvement of labour mobility, for example, to help farmers of non viable farms to leave the agricultural sector, first requires that the population concerned be identified, then eventually grant a single payment and retraining courses to those who accept to quit farming.

Comparing alternative approaches

Various alternatives that allow these objectives to be fulfilled should then be assessed ex ante in order to measure and compare their costs

and benefits, as well as to identify the winners and losers. Whenever possible, all costs and benefits should be taken into account, including transaction costs, positive and negative externalities, and negative consequences on trade.

We must also consider the brakes to reform and the contradictions with policies already implemented (for example, the role of institutions such as semi public organisations, producer groups, land and tax laws). The lack of policy consistency is a widespread problem.

Choosing the implementation mechanism

The institutions best able to implement the policy must then be chosen (public, private, semi public, with both a national and local administration level) according to the network in place and the policy range.

There are also various implementation mechanisms such as contracts. The choice of beneficiaries may be subjected to project appraisal (development plan). Some mechanisms, such as auctions, may facilitate the choice of beneficiaries. These issues are examined in OECD (2007b).

Follow up and assessment

The implementation of a policy must be regularly monitored and its parameters adapted if necessary. It is also essential that ex post results of a policy be assessed in order to learn lessons for the future. The follow-up and assessment process should provide relevant information for the development of future policies and for the analysis of economic phenomena in general (OCDE, 2007c).

OECD recommendations on reform adjustment

In addition to the general recommendations on cost efficiency, targeting, decoupling or policy consistency mentioned above, specific conclusions were drawn from policy assessments of adjustment reforms (summarized extracts from OECD, 2006b to follow). In particular, policymakers should verify that targeted adjustment measures, if their implementation is required for economic efficiency or public economy, be:

- Linked to precise deadlines with a well defined exit strategy,
- Oriented towards re-employment of those who lost their job, and
- Compatible with general social protection systems.

Policymakers should consider the capacity of the sector to adapt to new circumstances when they design reforms. Indeed, reform studies show that producers can create new opportunities when changes occur. Therefore, adjustment measures must be designed to allow the private sector to create new opportunities in such situations.

Adjustment measures must be oriented to precise goals and reach the right targets. They must also be largely decoupled from production and use of agricultural products in order to limit distortions. Policymakers should decide whether adjustment measures should focus on upstream or downstream activities, or whether general measures on retraining or redeployment of resources in the endangered sector are enough. More generally, and from the economic policy point of view and taking equity into account, policymakers should carefully consider who will benefit from subsidies and who will finance them in every adjustment programme.

When several support programs to adjustment are to be developed, their consistency and integration must be ensured. In the case of Ireland cited in Box 4, the early retirement and settling scheme were not completely integrated. For a scheme to be perfect, there must be an overall approach,

with the entry and exit policies being consistent and coordinated with one another. If the objective aims at training, this would be achieved more efficiently through a specific and targeted measure.

Deadlines for programs should be clearly defined. If not, they may hinder the adjustment they are designed to help. A farmer compensation measure for price or income drop due to a reform or liberalisation action may have the opposite effect to the ones expected if it lasts for too long a period of time. Moreover, it is extremely difficult to terminate a programme that has no time limit. Finally, the longer it lasts, the more new distortions it may create.

When land prices drop because of a reform, loss may be compensated to help the reform be accepted and to ensure equity (OCDE, 2007a).

All adjustment programs must have an explicit part dedicated to cessations of business to increase the adjustment schemes' chances of succeeding. Allowing those unable to be competitive to leave the agricultural sector through retirement is a potential strategy. There are examples of farmers connected to the general social security scheme, as well as examples of special farmer pension schemes. Policymakers can also propose temporary lump sum payments conditioned by cessation of business.

To conclude, adjustment programs can also plan training schemes to help retrain farmers who leave the agricultural sector. Many adjustment mechanisms aim at helping farmers remain in business by improving the viability and competitiveness of their agricultural holding. Nevertheless, such mechanisms should not encourage them to diversify into activities that are already strongly supported elsewhere.

The efficiency of the various measures will depend on the targeted sector's characteristics and the nature and quality of the basic resources. Policymakers may choose amongst a large variety of measures, some oriented towards the producers themselves and others of a more general nature. Among the formers are loan renegotiation, subsidies, as well as many kinds of technical assistance. Infrastructures development, quality improvement programs and promotional and marketing schemes count among the latter.

For an adjustment process to be successful, the people involved must be convinced of the irreversible characteristics of the reforms proposed and of the time limitation of the provided subsidies. Obviously, one-time measures or multiannual plans based on well known dispositions can be realized more easily than decisions taken year after year. Policymakers must therefore clearly explain their intentions, with transparency and, insofar as the political situation allows it, stick to the planned reform and adjustment measures. The preliminary planning and review process must limit risks of moral hazard and adverse selection.

Thorough studies undertaken before reform implementation and after the adjustment period help anticipate the effects of planned reforms and, therefore, identify fields in which difficulties may arise and where actors may be prejudiced. Adjustment measures should be designed and targeted with full knowledge of the facts. Though it is impossible to anticipate all consequences, the risk of granting too significant subsidies or to ill distribute them is greater when no studies have been undertaken. The impact of the reform on other sectors must also be anticipated and we must be aware of potential social and environmental costs that may arise. Furthermore, further assessing the measures during and after their implementation allows to draw lessons from the experiment and to use the latter in a potential reform of the targeted mechanism or in its implementation in other sectors.

For the desired adjustments to take place, an efficient review process must be planned, taking into account both the beneficiaries of the reform and those who will lose the most.

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Agriculture and Multi-functionality

David R. Harvey[1]

The brief

"Markets often take care of the interactions between agriculture and the environment. However, markets are partially or totally inefficient when "public" goods are involved. How can we estimate the value of particular public goods, in order to distinguish primary and secondary concerns? This is a particular difficulty in Europe, where civil society groups tend to have widely divergent opinions on such topics. How can we devolve operating (regulatory and budgetary) competences among local, national and European levels? What should be the architecture for the various Single Farm Payments?"

Summary

Agriculture has been multifunctional since it was first practiced, producing food, feed, fibre and fuel and power. So what is new (if anything) is the use of the term and concept to justify continued support for farmers and farming. The conventional argument in favour of such support is articulated in the brief—markets fail in the presence of externalities and/or public goods—so government (public) support/ intervention is necessary to correct these failures.

Markets fail because property rights are ill-defined or unprotected, and/or because the transactions costs (associated with the necessary negotiations and exchange between provider and beneficiaries) exceed the net benefits (surplus) generated by resolving the failure. However, if government intervention does not, either directly or indirectly, resolve the transactions cost or property right problems, there is no reason to suppose that the intervention can be any better than the failure it seeks to remedy. In particular, there is no reason to suppose that uniform payments to farmers or farms (as with the current Single Farm Payments) can possibly reconcile the different interests of the providers of CARE (conservation, amenity, recreation and environmental) goods and services, with the 'consumers', (the beneficiaries and valuers of the public goods or externalities) effective demands for these services. This 'solution' to the multifunctional problem, however targeted by compliance conditions, simply side-steps the fundamental problem; it does not solve it.

Introduction

The term "multifunctional" appears to have been recently relegated to a more minor role in the rhetoric surrounding the Common Agricultural Policy. The term appears only once throughout the European Commission's web pages which 'explain the Common Agricultural Policy', under the heading 'promoting sustainable agriculture in a global environment', where it is noted that "during the coming years the CAP will change further in order to continue to: (*inter alia*) support the multifunctional role of farmers as suppliers of public goods to society."

The conventional argument in favour of such support is articulated in the brief—markets fail in the presence of externalities and/or public goods—so government (public) support/ intervention is necessary to correct these failures. The reasons why markets fail are:

- ***Property rights are ill-defined*—**it is not clear who owns pretty landscapes or diverse wildlife, and hence it is difficult to identify the appropriate bargains between those who are capable of providing these goods and services and those who value their provision;
- ***Transaction costs are prohibitive*—**the time and effort needed to include all the beneficiaries in negotiations to determine

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how much particular provisions are worth, and to collect the subscriptions and organize for the delivery with the providers, are just too great to be worthwhile.

Nevertheless, it is argued that people do generally value these conservation, amenity, recreation and environmental goods and services (CARE), which may also include particular cultural activities and characteristics of an agrarian society. These are valuable and worth paying for, lest they decline or disappear. Therefore, the conventional argument continues, it is worth paying farmers a supplement on top of their market returns to encourage the provision of these CARE goods and services.

The nature of Care (multifunctional services)[2]

Careful consideration of multifunctionality quickly reveals that both the supplies of and the demands for the variety of different functions which agriculture, land management and land use both do and could generate are:

- Spatially differentiated and highly specific to local conditions and practices;
- Highly dependent on current personal preferences and future aspirations on both the supply and demand sides;
- In a continual condition of change and adaptation over time.

Three policy implications follow immediately from this consideration:

i) Uniform payments, authorized at the European or even national levels, cannot possibly match willingness to pay for multifunctional products of farming with the differentiated costs of their provision;

ii) Attempts to identify and measure the social value of these attributes of agriculture will always be highly contestable and heavily dependent on the particular and local conditions under which measurement is undertaken, however sophisticated applied economic analysis becomes;

iii) Attempts to provide such 'political administrative' solutions to the problem run very high risks of both failing to resolve the transactions and property right issues (and hence failing to solve the problem at all) and also of generating additional transaction and property right problems of their own—a double jeopardy.

We are in danger of repeating the mistakes of the past, though in a different guise. We have found that our original concerns about the security of our food supplies and the incomes of our farmers led us to develop and pursue policies which generated unsalable surpluses and higher cost farming, with little real effect on farm incomes. Now, perhaps, we are in equal danger of developing policies to provide for Care of the countryside which turn out to be both excessive in the amount of Care provided and the cost of its delivery, or fail to provide enough Care or the right types and mixes of Care.

In short, the answers to the questions posed in the brief are:

i) *How can we estimate the value of particular public goods, in order to distinguish primary and secondary concerns?* We cannot, with any degree of confidence, general acceptability or consistency over space and time. Such estimates as can be made, however carefully, will always be highly conditional on the

[2] These arguments are developed in Harvey, 2003, "Agri-environmental relationships and Multi-functionality: Further Considerations", World Economy, 26 (5), May, 705–725.

location, context and populations surveyed or examined, and cannot be relied upon to provide reliable and robust estimates of the values of care through time, especially if the estimation technique does not actually require respondents or participants to meet their bids and pay the costs of provision;

ii) *How can we devolve operating (regulatory and budgetary) competences among local, national and European levels?* Again, we cannot design any 'planned' or administrative provision of appropriate levels of multifunctionality effectively and efficiently. There is no systematic framework which allows for this possibility. Nevertheless, there is little if any justification for financial co-responsibility for the provision of Care across the EU as a whole. If the Single Farm Payment, with its condition that land be maintained in Good Agricultural and Environmental Condition, is to be justified as a Care payment—then it should be regionally and nationally differentiated, and paid for (very largely) by those who benefit from the Care provision—typically the nationals of the country concerned. Multifunctional (Care) delivery is clearly local—even administrative regions in Europe exhibit a range of different socio-natural environments and habitats, so the provision of Care, and the costs of delivery, varies even within regions. Although the relevant demand can only be identified for a particular and specific package of local Care, it may well be expressed by more than local inhabitants, and include demand from both nationals and others. There is no necessary correspondence between administrative regions and the 'markets' for care, so there is no obvious regulatory or budgetary competence at any specific level in Europe. However, at least for supply, the implication is that the local level is likely to be the most competent for delivery—though not, necessarily, for specification and payment.

iii) *What should be the architecture for the various Single Farm Payments?* Given the previous answers, there is NO architecture available for **administered** Single Farm Payments which can hope to provide appropriate (socially optimal or even consistently acceptable) multifunctionality. Even at the most basic level, any given Single farm payment, even if specific to a single farm, to can only be a second-best answer to the problem of Care provision, since even a single farm is capable of providing a range of multi-functional services. Certainly, there is no reason to suspect that the payments will be the same for all farms, even within a given region. Nor is there any reason to suppose that the payments necessary to secure the appropriate provision of Care from any farm will bear any relationship at all to the levels of support provided to these farms under the previous systems of commodity market support.

An answer to multifunctionality—the provision of CARE

There are, in fact, two major issues here: first, the *CARE problem:* how to develop socio-political processes and procedures to deal with multifunctional farming and the provision of CARE goods and services; second, the *Dependency problem:* how to get there from here (from a system which has delivered, and, by implication, promised to go on delivering support to European farmers because they are European farmers).

Consider the *Dependency problem* first (see Harvey, 2004[3]). Single Farm Payments are the

[3] "Policy Dependency and Reform: Economic gains versus political pains," *Agricultural Economics,* 31 (2–3), December, 2004, 265–275.

(final?) incarnation of a history of farm support within the EU, and encapsulate the benefits of this support to the European farm sector. Elimination of this support would, especially if done overnight, cause substantial problems for the current farm population, and is, as a consequence, very difficult for European politicians to contemplate, and also potentially very inefficient in terms of the additional adaptation and adjustment costs which such elimination would generate. Since farmers have taken production and investment decisions on the assumption that such payments would continue, they need the capacity to adjust and adapt to conditions in which they no longer exist. In short, they need and deserve some compensation/adjustment assistance for removal of support.

The cleanest, easiest and most efficient and effective way of providing this assistance, as well as the appropriate signals for the necessary adjustment, is the lump sum payment (CAP Bond).[4] The SFP, given the inability of the European Government to issue a Bond (or borrow money for a lump-sum compensation payment), is perhaps the closest practical alternative to the CAP Bond. In this sense, the SFP is best seen as compensation for the reduction (and eventual elimination?) of commodity or area based support. To dress this payment up as a payment for multi-functionality (Care) is to thoroughly confuse the issue.

If the SFP is actually compensation for elimination of market support, then it is necessarily finite. Not only are the individual payments limited, but also they should only be allowed to continue for long enough to provide the necessary adjustment assistance towards a free market. There is no long-term case for continued compensation. European Agriculture is not inherently disadvantaged relative to international competition, and is perfectly capable of surviving and prospering alongside imports from elsewhere. Although there is clearly some public sympathy for arguments in favour of self-sufficiency—that our own supplies of food are more reliable, more deserving of support, of better quality and provenance than competing sources from elsewhere—the idea of self-sufficiency is actually self-defeating. No individual household is content to be self-sufficient, for the simple reason that they can be much better off trading what they are relatively good at for goods and services which would otherwise be very expensive in time and effort for it to provide for itself. The same logic applies exactly to localities, regions and countries. No doubt, the larger the community considered—up to the scope of the present European Union—the more opportunities there are for profitable trade within the borders, and (possibly) the smaller the gains to be made from extending trade beyond the community boundaries. But, even at this level, trade is still more sensible and sustainable than self-sufficiency, especially in a world faced with the prospect of feeding another 3bn people within 40 years. As societies and their markets become richer and more sophisticated, there are increasing opportunities for people to express and exercise their own preferences for local products and services, and more niches in which these activities can flourish. There is no longer any justification for supposing that European agriculture needs special treatment or support simply because it produces food (or feed, fibre and fuel). This logic says clearly that the SFP (as compensation) should be phased out. Since the present policy is only legitimized to 2013, it makes some sense to terminate the SFP at that date.

What about the *CARE problem*? Markets deal with 'multifunctionality' in both supply and demand far more effectively than any administrative system yet devised or conceived—markets are simply fantastic at organizing effective exchange: at collecting

[4] A. Swinbank and R. Tranter (eds): *A Bond Scheme for CAP Reform,* CABI, 2004.

widely different individual valuations of goods and services and transmitting these to an almost equally wide variety of actual and potential suppliers, and matching the one with the other. Market failure is, then, a serious problem. Except, that is, where it is these markets themselves which 'decide' that the additional satisfaction to be gained from dealing with these failures simply does not warrant the extra effort and cost involved in internalizing the externalities, and collective organization of public goods. In this sense, 'market failure' is the wrong label—the market doesn't fail as such, it simply says that the effort to deal with the issues is not worthwhile. But, if the transactions costs can be reduced—encouraging those willing to pay for the various functions of farming to pay for the services of farmers and land users—then we could expect satisfactory quasi-market solutions.

How might we do this? By encouraging voluntary organizations (Conservation, Amenity and Recreation Trusts, CARTS)[5] to elicit and collect consumer and constituent willingness to pay for particular packages of multifunctionality in specific places, and for them to organize the delivery from farmers and land users. But, surely, this approach is already available? It is already being used, as a prime example, by the British Royal Society for the Protection of Birds, but not to a sufficient extent. Why not? For two major reasons: first, the free rider problem—too many people chose to free ride on the rather small provision generated by voluntary action; second, the Dependency problem (above)—people have got used to governments being the vehicle through which these problems are solved, and have yet to grow accustomed to thinking and acting for themselves through charitable trusts and voluntary action.

The first of these problems is relatively simple to overcome—simply estimate the extent of the free-rider problem: is it likely to lead to a 50% underfunding, or 80% or 100%, of the CARE services? Then provide from the public purse a grant-in-aid payment to each of the trusts to make good the free-rider shortfall. The only administrative effort necessary would be an ombudsman/auditor function to make sure that the trusts so aided were legitimate Care providers. Incidentally, this approach could also be used to allow for the 'merit' good arguments in favour of support for multifunctionality.[6]

The second problem, dependency, is much more difficult, as any addict well knows. A radical solution might be to allow all voluntary contributions to be fully tax-deductable (to be allowed as deductions from tax owed), to encourage people to act for themselves, rather than relying on government to do the job. However, further consideration of this approach quickly leads to the obvious possibilities of 'excessive' voluntary contributions, merely to avoid paying any tax at all. Clearly there would need to be upper limits to tax deductibility, if this approach to government organization of collective good provision remains limited to multifunctional services, rather than extend to many other forms of present government activity.

Of course, this is a radical departure from our present systems of governance. It is clearly widely believed that 'farming is different', and is 'more than economics'—that it is far too important to be left entirely to the market. Farming is, according to this belief, necessarily and inherently political, demanding and requiring specific political treatment (and support) "reflecting

[5] Dwyer, J.C. and Hodge, I, *Countryside in Trust,* Wiley, 1994.

[6] Merit goods are frequently confused with public goods, but are different. Merit goods (and services) are those which society judges to be too important to be left to the market to provide, since markets work according to willingness to pay, disadvantaging those who are poor and not able to pay. Classic examples are health and education, and (sometimes) access to justice.

the expectations of society as a whole."[7] The problem can be re-stated as one of questioning the competence of our political systems to take collective decisions on our (the constituents) behalf. In so doing, it is clear that an alternative which offers release from the political straightjacket, or threatens to eliminate the politics, depending on one's point of view, is likely to raise considerable opposition—we have grown dependent on our politics to take decisions for us when private action does not deliver what we want. And, because of this dependency, we do not easily appreciate or welcome suggestions that our reliance is misplaced and that there are potential alternatives. Fear or mistrust of novel ideas may also play a part in a natural antipathy towards radical suggestions.

Furthermore, it is clear that people, and even 'countries', show different levels of respect and trust for their present political machinery. Those who hold present political machines in high regard can see no point in questioning their ability to deliver and implement the 'right and proper' balance of multifunctional activities, structures, goods and services. These people, and countries, therefore, see no reason to question the capacity and competence of their political machinery, and see no reason why SFPs cannot and should not be used to pay farmers to deliver the Care that society wants, which, in turn, will be perfectly adequately determined and delivered through the conventional political machines. For such people, the conventional justification for continued SFPs, appropriately targeted and conditional on delivery of multi-functionality and Care, is more than adequate.

Of course, these people (and countries) should rationally expect some opposition—which might well claim that the levels of care provision and the costs of delivery are not properly determined through the present political systems. Voters are too inclined to spend other peoples' money, political interest groups are more extreme in their views and demands than the general constituencies, small but coherent groups and organizations (farmers, wildlife enthusiasts) can be more politically influential than large and more incoherent groups (citizens, consumers, constituents), whose members are affected relatively marginally by any action or policy. Administrators are neither providers of care, nor direct beneficiaries of the provision. As such, they have little incentive or competence, other than bureaucratic efficiency and organization, to monitor constituents' demands for care and providers' capacities, especially at highly differentiated local levels.

Furthermore, it seems likely that the world faces the prospect of increasing real prices for both food and fuel, as it seeks to continue growth to feed a still growing population, and provide them with more decent standards of living. As this happens, so the appropriate trade-offs between care and production will change. Bureaucracies are not well known for responding effectively or rapidly to changing circumstances and priorities, running the substantial risk of delaying response and exacerbating inappropriate, and possibly counterproductive activities.

However, notwithstanding these arguments, there is little doubt that many countries will not be willing to release agricultural multi-functionality to the uncertain and apparently uncontrollable quasi-market place of competing trusts. Nevertheless, there can be little dispute that financial co-responsibility across the European Union for payment for care—the sole justification for the successors to SFPs—is no longer justified and should be eliminated, to bring the "CAP" into line with other European policies, which all require

[7] As one discussant remarked.

co-financing by member states.[8] The demand for care is largely (though not entirely) confined within national boundaries and does not (except in rare cases) extend throughout the Union. Even when it does, it also extends beyond the Union's boundaries. Member states should be largely left to their own devices to service their demand for care, subject only to the competition policies of the EU. There is very little justification for a Europe-wide policy on this provision, still less for European funding.

Conclusions

Farming has been multifunctional—producing many different things people want and are willing to pay for—ever since it was first practiced by our ancestors. Furthermore, markets are the best device we have yet invented to solve multifunctional problems—after all, what is more multifunctional than having a life or earning a living? Attempts to solve the problem of agricultural multifunctionality through administration and Government are very likely to produce both inefficient and ineffective answers.

Yet it seems likely that the Single Farm Payment will evolve into a targeted payment to farmers for their multifunctional services—their Care provision. As it does so, the justification for financial co-responsibility for the policy disappears—member states should pay for (and define, design and implement) their own Care programs, as they see fit, since uniform, pan-European definition and design is necessarily and inherently beyond the competence of the European Union, simply because of the differentiated nature of Care provision and demand.

Once Care is made a national rather than an EU responsibility, there is no logical reason why individual member states should not be able to adopt different approaches and solutions, including the possibility of delegating organization of provision to Conservation, Amenity and Recreation Trusts (CARTs). Indeed, competition between member states over how to provide for appropriate levels of Care should be expected to identify those approaches and systems which are 'best fitted' to the local conditions and aspirations.

The EU role in such a system would then be confined to: regulating competition between member states, to ensure that states do not seek to distort competition in food, feed, fibre and fuel markets; promoting economic development, including rural development; promoting cohesion between regions; promoting R&D to develop and expand the potential of European agriculture and land as multi-productive resources.

[8] See Harvey, D. R., "The EU Budget and the CAP: An Agenda for the review?," *EuroChoices,* 5 (1), 22–27, 2006. As a consequence of the elimination of financial co-responsibility, the UK would, of course, be expected to give up her claim to the special rebate.

Agriculture and Risk Management

Per Molander[1]

Introduction

Risks are omnipresent in human life and some strategies of protection are as old as mankind. In pre-industrial societies, regular risks prevail: war, famine, plague. The development of a modern society reduced or eliminated these classical risks while introducing new vulnerabilities—car accidents, remote market dependence, etc. In every sector, the risk overview is constantly changing. Therefore, risk management must follow this evolution and adapt itself to its environment.

Many risks are settled everyday on an individual level. Most households buy a comprehensive insurance against fire, burglary, etc. Private savings are used in case of unexpected expenses. For some risks, however, decentralized solutions are inefficient, and insurances based on public intervention are better adapted.

Therefore, a strategy adapted to a given sector must answer the following questions:

- What are the most important risks to consider?
- What are the main alternatives to manage these risks?
- What potential market failures may require State interference?

Risks in the agricultural sector: An overview

Production Risks

Meteorological risks (hail, storms, drought, frost, etc.), plant and domestic animal diseases belong to classical risks of the agricultural sector.

Consequences of meteorological variations depend on different factors—choice of plants or animals, microclimate conditions, soils, plant physiology, etc. Drought constitutes a risk not only in the Mediterranean area but also in the Baltic area, as well as in some regions along the Danube. Massive rainfalls occur mostly in Eastern Europe while frost increases in the North and in the East of the EU, with quite significant local variations.[2] Sanitary risks are more difficult to locate. Epizootics often happen on large territories and counter measures can also affect regions exempted from the disease.

From the consumer's point of view, threats from classical risks are now obviously less important than before. In the 1860s–70s in Scandinavia, poor citizens could die of starvation after a bad crop. This risk has been eliminated thanks mostly to higher productivity in the agricultural sector, but also—which is even more important—thanks to the general economic development based on a free international trade that allows to import commodities like chemical fertilizers and food products.

From the producer's point of view, classical risks represent, indeed, a real threat. It is an overview in constant change, that includes the perspectives of climate change, avian flu, etc.

Market risks

In every market, price balance is gained by the interaction between supply and demand, and changes in one or the other implies variation of prices. Variation of prices is therefore natural; no variations, however, would require an explanation. Nevertheless, these common variations of prices are sometimes viewed as unacceptable, and prices are then administratively managed. This occurs for employment markets

[1] Consultant at Mapsec, Stockholm and former analyst leader of agricultural policy reform in Sweden. Paper translated into English from the original French by Barbara Bender.

[2] EC (2006).

in most industrialized countries. It works the same for agricultural products in the European Union and other countries of the OECD. As a consequence, somehow paradoxical, the variation of producers' income increases more when variations are natural because these latters are dimmed by price variations—which go on the opposite—in a non-regulated market.

Political Risks

Political changes may directly affect the agricultural sector (subsidies, import restrictions, environmental policies, etc.) or indirectly (tax policies, transfers to households, etc.). The first category of changes is the most interesting for the present discussion since the agricultural sector is quite similar to the other economic sectors, with regard to indirect effects.

For historical reasons, the agricultural sector is highly regulated in most of the industrialized countries, leading naturally to political risks: increased security in terms of commercial risks involves increased exchange of political risks. It is also the alternative to a sector more devoted to consumer's demand and normal economic conditions should be implemented in that perspective. Moreover, political risks are radically different from regular risks in that it is impossible to set probabilities to the risks incurred and, therefore, it is more or less impossible to insure them.

Human Risks

There are, in the agricultural sector, as in all economic sectors, risks affecting either owners or employees—diseases, accidents, change in family status, human capital depreciation, etc. The agricultural sector is then no different from other economic sectors and debating counter measures to implement must be made in a general context.

There are strong arguments in favour of a public intervention in social security for employees, some of which are also pertinent for small entrepreneurs, but this issue is general and does not require specific debate for the agricultural sector.

Risks threatening agricultural assets

A specific group of risks threatens agricultural assets—flood, fire, ground water contamination, etc. The limit, here, lies between risks threatening an individual enterprise—risks requiring no other counter measure than a conventional insurance—and collective risks like floods or, ultimately, radioactive fallouts, that can threaten the production capacity of a whole region. In the latter case, the State is obviously the natural insurer.

Financial Risks

Financial risks represent a sub-category of market risks. As in other types of risks, there are general risks—as in the variations of interest rates—and specific risks—as in the variations of tenant farming. The level of this latter should be adjusted to the effective soil yield, creating an automatic mechanism of adaptation. However, the possibility of too long renewal intervals according to the price variations may impede the process. The question to determine whether it would be a real problem or not depends on the general legal frame. For example, legislation on contracts in Sweden allows each party to re-open the negotiations if the external conditions under which the contract has been signed have changed significantly.

The agricultural sector: An exception?

Some of the above mentioned risks are specific to the agricultural sector, but others are general. The main issue for a sectoral risk policy is to determine whether the range of risks justifies a public intervention. In other words, is the level of general risks higher in the agricultural sector

than in other similar sectors? And does this characteristic of the risks differ from the other sectors' in a way that requires a public intervention?

Much has been written on "the specificity of agriculture" debating the characteristics of the agricultural sector vs. others sectors dominated by small and medium sized enterprises. Among the hypotheses, the following can be noted:

- The variability of meteorological factor is higher than in other sectors;
- The output turnaround time (sowing-harvesting, investing in piglet-slaughtering) is specific to the agricultural sector;
- The stronger capitalistic intensity;
- The unusual producers' response to price variations ("inverse supply curve");
- General conditions in a sector in contraction are particularly difficult;
- Collective services produced by the sector—food security, environment-oriented services, etc.—are not well rewarded.

These issues have been dealt with previously.[3] In this paper, the analysis will only deal with risk management.

A variety of solutions

Various risk management solutions have been developed in different sectors of the economy. Some of these solutions are adapted to the specificities of the present sector, but there are a large number of strategies and tools that can apply to every sector. The choice between the existing solutions must be made according to the efficiency criteria, which is determined according to :

- ***The risk nature:*** risks are known as **independent** if the probability that a producer will be hit is the same as if the other producers of a same product (or a similar product) will be hit or not; Otherwise, the risks are known as systemic.
- ***The risk importance:*** The financial and administrative cost of a given solution is only justified if the risk does not exceed a certain level.
- ***The existence of market failures:*** in some situations, the market given solutions are not efficient, and a public intervention should be sought. However, it is not possible to draw the immediate conclusion that this public intervention is justified, because the State, as an insurer, does not always have access to the required information for the insurance to be efficient. Moreover, we must decide whether the advantages linked to a public intervention are higher than the administrative costs.
- ***The issue of income distribution.***

Risk absorption

Variations of outputs and prices are traditional risks in the agricultural sector. In the past, the population had to adapt to annual variations. Nowadays, the interaction between producers and markets have made the traditional solution obsolete—farm stocks. Now, producers use financial means—savings and loans—to absorb variations. In many countries, tax law allows farmers to transfer income from one fiscal year to another in order to eliminate these variations as much as possible. Indeed, risk absorption at the individual level is preferred whenever adequate.

[3] Molander (1993).

Trade as an insurance

Meteorological variations are more or less independent from one place to another. For example, hail is local. The larger the geographical area of potential risks, the more independent the variations. It allows to absorb climate risks by enlarging regional and global markets. Therefore, regional and international trade contributes to lessen the risks from the consumers point of view. Nevertheless, trade also gives possibilities to farmers. When a regional or national market shrinks, farmers may search for customers elsewhere. The settling of farmers abroad may also be analyzed as an insurance strategy that offers other possibilities as well, such as the development of new products and services.

Diversification

The main goal of a household is to ensure a sufficient global income, a natural strategy against agricultural risks is to seek income outside this sector. In the past, farmers found an additional occupation in craft industry, or small scaled industrial activities. Nowadays, thanks to the transportation means, a large number of alternatives also lie in the urban sectors of the economy. Firstly, further income may be found using farmers' competence or other farming assets, in horticulture, obviously, but also in further-related sectors. Tractors and other vehicles can be used for transportation, snow removal, excavation, etc. Tourism is a growing sector in rural economy. One of the parents in an farmers' household may also have a job non- or little related to the agriculture—as teacher, driver, electrician etc. These solutions are obviously very efficient to stabilise households global income. The additional income contributes both to raise the level of household income and to lessen its vulnerability to a given level of variations.

Insurances

The simple idea of insurance is to share the risk linked to a given activity between all those affected by this risk. Typically, a large number of individuals take an equal risk associated to a high cost, but with a low probability. By sharing the risk, the affected individuals have to worry for medium risk only—a trifling cost compared to the maximum cost—and for the administrative cost necessary to manage the insurance. This approach works very well for insurable risks i.e. risks for which probabilities and costs associated to the various disasters are well known—such as fire, car accidents, etc. All these insurable risks are constantly developing: for example, today, there are insurances against the consequences of political assaults on the international market.

Typically, a number of factors tend to make things more complicated. First, all individuals do not face the same risks. For an insurance to be efficient, insurance premiums must be adapted to the different levels of risks. Therefore the insurer must have access to the relevant information about the policyholder, which is not always the case. The absence of premium adaptation to risks leads to the problem of adverse selection, i.e. individuals associated with the lowest levels of risk leave the insurance programme (too expensive for the risk threatening them). It compels the insurer to raise the premiums, thus risking to reduce the number of participants even more. To some extent, the market may disappear.

Secondly, when risks are natural (for example meteorological risks), probabilities are usually independent from the policyholders' behaviour. However, in other cases, risks may be affected by the policyholders' behaviour—a phenomenon

known as moral hazard. In such a case, an insurance may induce policyholders to take more risks, obviously a counterproductive effect. The counter measure usually chosen to fight this effect is called a deductible.

Harvest/crop insurance

The harvest insurance is a long established institution in many industrialized countries. The insurance protects against severe damages when weather conditions are bad. Insurable crops, as well as insurance parameters, such as minimum income insured according to the hectares involved, vary from one country to another. In some of them, the harvest insurance is managed by the government, but it is perfectly possible to manage an insurance fund on a strictly commercial basis. Sometimes, public intervention consists in just a tax subsidy. Anyway, it has to be deductible for the firm.

Forward contracts

Often, a product producer and buyer have a common interest in eliminating a risk. In the agricultural sector, quantities and prices on delivery date are usually unknown when the production is decided. Therefore, the two partners can conclude an asset sale agreement at a future price and date, stated in a contract called a **forward contract.** As there is no standardisation, such contracts are negotiated by mutual agreement between the two partners.

A forward contract allows for eliminating most of the financial risk. However, there are some disadvantages. It is not possible, for the producer, to insure his entire crop as its quantity is unknown at the time the contract is made. If 100 per cent of a regular crop is insured by the producer, and the real crop amounts to only 80 per cent, he will have to buy the difference on the market which—in a time of shortage—may prove very expensive. Usually, 80 percent of the regular crop is insured in a forward contract.

The second disadvantage is that forward contracts may generate risks of liquid assets. Due to the special conditions of the contract, it is very difficult to assess its position before the expiry date. Moreover, it is not before the expiry date that a potential failure of one of the partners can be noted. For these reasons, more standardised contracts—**futures contracts**—have replaced forward contracts as the main risk management tool at the international level. Nevertheless, forward contracts are often used between primary producers and merchants.

Futures markets of financial tools[4]

A futures contract is a standardised delivery contract in which quantity and quality of an asset (crop), expiry date and place of delivery are stated. Futures contracts are negotiated on an organised market, thanks to a standardised format. Their modern type was first used in the mid 19th century in the United States on the cereal market. They are very general and are used for a large number of commodities and basic products (oil, natural gas, gold, silver, etc.) as well as interest rates.

The difference between futures markets and forward contracts lies in standardisation, the existence of a clearing house, with central counterparty. When buyer A buys a contract from seller B, he, in fact, buys from the clearing house, and B sells to the house. The risk management is thus centralised in the clearing house. To ensure this function, the clearing house requires a certain amount as an initial margin and a variation margin used to re-build the deposit if the latter has been reduced by the market variations.

[4] For an overview of financial tools, see Hull (2006).

The majority of the transactions covered by futures contracts are never realized. The reason is that these contracts are usually combined with **options**. An option allows for buying (call option) or selling (put option) a given quantity of underlying assets that can be stocks, commodities, futures contracts, etc. A producer who wants to sell all of his crop but can only be sure to be able to produce 80 percent of it can thus conclude a futures contract for 100 percent and, at the same time, a call option for 20 percent of the crop.

These financial tools constitute a kind of insurance against market variations. What is remarkable, compared to regular insurances, is that this type of insurance does not require an insurance premium on top of the net administrative cost. At any time, the equilibrium price on a futures market represents a kind of average between highest and lowest prices. The fact that various actors make different forecasts is explained by the fact that some of them have personal sources of information or that they draw their own conclusions from the information available to everybody. As a result, some actors are ready to buy a certain quantity of call options at the equilibrium price because they think they can sell it higher; On the opposite, there are people ready to buy a certain quantity of put options at the equilibrium price because they think they can buy it cheaper than the market price. The closer we get to the expiry date, the clearer the real value of the various alternatives and buying/selling tools are settled. However, only a tiny percentage of these physical transactions made on the market amounts to deliveries of the product.

The State role

General motives

Are potential market failures important enough to justify public intervention? To suitably answer this question, we must set a general frame. As market failures are well analyzed by economic analyses, we will only briefly examine them here.[5]

Negative externalities

Negative externalities are the most famous example of a market failure: an operator A is disadvantaged by actions linked to operator B without compensations. The negative consequences of an industrial production on the environment are typical examples of negative externalities. Without public intervention, being a restriction or a tax, negative externalities would create an inefficient resource allowance.

Collective goods

Externalities can also be positives. Agriculture and arboriculture represent activities producing mutual positive externalities. The asymmetric situation where someone produces a good that can benefit other actors without contribution is a problem as this good will not be produced in a sufficient amount to make the market efficient. In the worst situation, the good will not be produced at all. Infrastructure—roads, television etc.—is often considered a collective good, but the collective characteristics depend in some measure on the chosen technology. For example, it is possible to finance road investments by taxes, or limit the access to TV programs by using security keys.

Long-term decisions

The ideal market is based on the individual rationality idea. However, this can lead to inefficient decisions from a social point of view if they are decisions with very long term effects. A Swedish forest will be mature at the age of 80 to 100 years, and those who plant a forest will thus be dead before they benefit from their investment. For

[5] See for example Musgrave and Musgrave (1989), Molander (1999).

this reason, it is a forest management law that must require that a felling area be reforested in order to ensure a sustainable management of forests.

Availability of information

The economic market theory lies on the fact that actors are well informed. This condition is not always satisfactory. Information can be bought like any other service but it is particular in the sense that the buyer does not know its value before buying. For this reason, some actors may find themselves in a market equilibrium characterised by poor information and, therefore, inefficient. To avoid such consequences, basic information must be required for consumers.

Problems of autonomy

Problems of autonomy are updated by alcohol and drugs and have no link with agricultural policies.

Inefficient markets

The basic model of market expects operators to be numerous, and the actions of any operator affect the market equilibrium only marginally. In some markets, there is a not inconsiderable risk of oligopoly or monopole. Such a situation will be characterised by a level of production too low and an level of prices too high according to a free and efficient market. Therefore, a market watch is a compulsory tool for economic policy.

Inefficiencies can also rise from other unfavourable conditions. We have already mentioned problems associated with the production of insurances—moral hazard, and adverse selection. None of these two problems justify in themselves a reason sufficient for a government intervention however. A specific analysis must then be made in each situation to check whether the reasons are sufficiently important to require legislative measures.

The income redistribution's policy

Even if the market is inefficient, the income distribution can be considered as unacceptable, requiring a redistribution policy. What is most efficient in such situations is a general policy. A sectoral redistribution policy may end with an inefficient allocation of resources, drawing a large part of the capital and workforce to the sector involved.

Macroeconomic stabilisation

Finally, there are arguments in favour of a government intervention, in policies linked with the economic climate. The debate on this topic is not relevant for the agricultural policy.

Consequences for the agricultural policy

Negative externalities

Negative externalities exist in the agricultural sector as in other economic sectors, and must be treated the same way—by taxes, restrictions etc.

Collective goods

The agricultural sector produces various collective goods. Food security, in the case of a crisis or a war may justify specific measures of planning. During the reform of the Swedish agricultural policy in 1990, the government decided to ensure a level of oleaginous plants production satisfactory in the country.

More important today is the system of contracts to ensure biodiversity linked to agricultural activities. The National Administration for the protection of environment in Sweden has signed a large number of agreements with individual producers in that purpose. The choice of the objectives of these contracts is based on a meticulous study of the present flora and fauna.

The insurance market

The ultimate producers' purpose is to ensure as much as possible a stable enough income at a satisfactory level. In their opinion, the ideal would be an insurance able to secure this level of income. However, such global income insurance does not exist for any other category of entrepreneurs. Moreover, such a goal can not be achieved even if we'd like it as problems linked to moral hazards are too important. The State-Insurer would never have the information required to decide whether the client has made sufficient efforts to qualify for the given insurance. The only solution consists in considering the risks one after the other and finding partial solutions which, in their whole, would give a satisfactory global result.

Regarding general risks—diseases or the producer's accidents, fire, etc.—there are tools provided either by markets or by the social security system. For more specific risks, such as weather conditions, the situation is similar. Meteorological phenomenons are known well enough to allow a statistical analysis and a thorough calculation of premiums. Even for relatively important damages covered by the crop insurance, it is possible to create an institutional solution independent from the government as shown by Canadian and Swedish examples. It is only for disasters that government intervention is justified. The problem lies in defining unambiguously what "disaster" stands for and to state that definition ex ante; otherwise, private insurers will hesitate to sell insurances.

The problem of moral hazard is very strong in the agricultural sector. For example, farmers may face different levels of risks according to their choice of crops, production methods, etc. Private insurers seem more able to solve this problem than the state because the formers will not hesitate to put deductibles to avoid farmers to take too high a risk. However, political pressures may encourage the government to subsidize this insurance, thus raising the level of risk in the sector.

However, the State seems more competent to solve the problem of adverse selection wherever it exists. The market tends to diversify premiums according to the farmers' risks, which may not be wanted from the income distribution point perspective. On another hand, this risk does not seem very frequent in the agricultural sector. If there are very low income farmers, the appropriate solution would lie in a general subsidy within a social policy, to avoid affecting resource allowance.

Farmers have recently been more sensitive to international price variations, which is new from the European point of view. It does not necessarily mean that income variations become more important since incomes are determined by the combined effects of prices and quantities. For producers who wish nevertheless to be insured against price variations, futures markets are effective tools. Obviously, these solutions require knowledge of financial markets, and it is understandable that farmers may rather concentrate on their companies' activities. From there on, collective solutions seem a better alternative. It implies for the individual producer to seek simple solutions like the forward contract in relation to the merchant, when the latter—being a firm belonging to the farmers—use the more sophisticated tools of international markets. (see § 5.5).

Summary

Finally, all arguments in favour of government intervention today are weak. The only exception where such an intervention seems justified is the protection against natural disasters. In the other fields, the role of the State in risk management must be limited to see that the insurance market is running satisfactorily. It seems also profitable that the government

warns farmers of the risks associated with the use of sophisticated financial tools.

The main role of the EU must consist of watching national crop insurance systems in order to secure that basic farmers' conditions be similar within Member states.

Sweden's present situation

A brief introduction

Some basic data

Agricultural sector development in 19th century Scandinavia is typical of industrialized countries. On the eve of the second world war, more than half of the Swedish population lived in the country and depended mainly on agricultural sector and forestry income. Nowadays, only a few percent of the workforce works in these sectors, and the agricultural sector's share in the GNP is no more than 0.5 percent in Sweden. The enlarged EU represents a more heterogeneous development as indicated in Table 1.

In short, classic economic sectors cannot play their historical part any more. Technical development, plants and domestic animals' improvement and other factors have created a situation where a minimum percentage of the population can feed a whole population. To ensure both level and stability of farmers' income, the households that work in these sectors must have links with other parts of the economy. This was also understood by people that remained in the country during the drift from the land period. Among those people, many strategies of risk management have developed in a more or less spontaneous way, like diversification.

Cooperative enterprises

In most industrialized countries, the primary agricultural sector is mainly composed of small and medium enterprises. Buyers of primary products, wholesalers and agribusiness are fewer, which may create an asymmetric situation close to a monopsony. For this reason, farmers have tried to get organised in order to increase the power of

Table 1. Employment share of agricultural, forestry and fisheries' workforce in EU in 2005 (% of workforce).

Country	Employment
Germany	2%
Austria	6%
Belgium	2%
Cyprus	5%
Denmark	3%
Spain	5%
Estonia	5%
Finland	5%
France	4%
United Kingdom	1%
Greece	12%
Hungary	5%
Ireland	6%
Italy	4%
Latvia	12%
Lithuania	14%
Luxemburg	2%
Malta	2%
Netherland	3%
Poland	17%
Portugal	12%
Czech Republic	4%
Slovakia	5%
Slovenia	9%
Sweden	2%
EU-15	4%
EU-25	5%

Source: Eurostat.

negotiation. Though they are small enterprises, the situation is similar to the working class' in Scandinavia, where the workers' movement was politically close to farmers' collective organisations. These organisations have developed their own processing industries, offering consulting, etc., creating thus a common base to manage collective risks. As this industry developed, it got closer to commercial services, the difference lying in the clients also being owners. Risk management services are therefore identical to those provided by regular insurances. Nevertheless, the presence in markets of enterprises owned by farmers' associations constitutes a significant factor in the functioning of these markets.

Indicator of success

The relative number of bankruptcies shows the producers' capacity to manage risks linked to a specific sector of the economy. Even in a well functioning sector, enterprises open and close constantly; zero is not the ideal. Moreover, large enterprises survive better in difficult times. To make a worthy comparison, distribution and size of the operators must be comparable. Table 2 shows the relative number of bankruptcies in some sectors of the Swedish economy controlled by small and medium enterprises.

The table shows that the bankruptcies frequency is significantly lower—nearly ten times—in agriculture and forestry than in other sectors Though the sectors' general conditions are different, this result suggests that, in general, farmers know how to better manage the sector's risks.

Diversification

As mentioned earlier, additional incomes, sometimes from non-agricultural related sectors, play a significant part to ensure a stable and

Table 2. Number of relative bankruptcies in some sectors of the Swedish economy (2007).

Sector	Number of enterprises	Number of bankruptcies	Bankruptcies, percent
Forestry	114,005	36	0.032
Agriculture	94,328	34	0.039
Fishery	1,723	5	0.29
Computers	31,855	144	0.45
Research and development	3,319	21	0.63
Transportation, travel agencies	33,323	210	0.63
Renting	5,856	44	0.75
Wholesale market (excl. vehicles)	48,435	481	0.99
Retail business (excl. vehicles)	66,236	669	1.01
Automobile industry (Trade and services)	20,048	235	1.17
Hotels and restaurants	27,607	371	1.34

Source: Statistics Sweden (2008).

Table 3. Swedish farmers' net average income (SEK) by surface area (number of hectares) (2004).

Surface	Income from professional activities	Capital income	Total
2.1–5.0	347,600	6,300	353,900
5.1–10.0	334,300	8,200	342,500
10.1–20.0	314,500	16,200	330,700
20.1–30.0	302,800	25,000	327,800
30.1–50.0	296,300	33,700	330,000
50.1–100.0	313,100	41,000	354,100
100.1–200.0	335,700	49,400	385,100
> 200.1	358,600	65,500	424,100
Moyen	320,700	23,100	343,800

Source: Statens Jordbruksverk (2007).

adequate income to households. This strategy is shown in Table 3, summarising the part of these additional incomes in Swedish farmers' households.

The figures show that the level of income is more or less independent from the farm size. Obviously, farmers manage to compensate their income when insufficient because of the limited size of the farm. These additional incomes come from various sources. The integration of rural society in the urban economy is made possible through developed transportation means. Though Sweden has a low density of population,[6] more than 90 percent of arable land is located within 40 kilometres of a city of more than 10,000 inhabitants, a distance easily covered by a 30 minute car ride. The significant transformation of the economic and social structure shown in the table is known as *urbanised country*. More than stabilising the income, this household strategy also allows for more intense cultural exchanges with non-agricultural society, and, in a general way, a higher standard of living.

Crop Insurance

Crop insurance existed in Sweden from 1961 to 1994. Initially, this insurance was managed by the government. In 1988, the fund was privatised and the liability was taken over by the Farmers' Federation. The fund was dismantled when Sweden became a member of the EU. The government still manages disaster liability, though.

Financial tools[7]

Cooperative enterprises play a dominant part in agricultural markets in Sweden. Buyers—Svenska Lantmännen, Svenska Foder, Kristianstad Lagerhusförening, private companies—offer forward contracts to eliminate most of the uncertainty at farm level. This type of insurance covers the basic products—cereals, oleaginous plants, some animal products—as well as fodder for the breeders' sector. Svenska Lantmännen also offers the possibility to store

[6] About 20 inhabitants per square kilometer.

[7] Clarin et Karlsson (2008).

the crop before making a financial deal, to allow maximum liberty of action to producers.

Buyers also use the whole range of financial tools—futures contracts, options—for contracts on international markets. This way, it becomes possible to make good use of all the advantages of sophisticated tools without the farmer's daily management—reasonable work sharing.

Since 2007, one of the commercial banks—Handelsbanken—offers a platform for futures contracts trade on international markets. Registered customers can buy or sell contracts through the internet on international stock exchanges. To date, it concerns about 400 different contracts, 12 percent of which are in the agricultural sector. The use of this opportunity is still limited to the biggest enterprises,[8] but the interest grows as international prices affect farms planning.

For the insurance against price variations to work properly, market price movements must be coordinated with producers' local variations. The existence of European stock exchanges with developed futures contracts markets is therefore essential as harvests in America are not always in accordance with Europe's. NYSE Euronext, is the prevailing European stock exchange. It was established in 2007 by a merging of NYSE Group and Euronext, and has headquarters in Paris, Amsterdam and London. There is also an independent stock exchange in Hannover, RMX, which offers futures contracts for livestock (piglets and pigs), and stock exchanges in Budapest, Sofia and Warsaw.

Conclusions

The risks overview in the agricultural sector is broad and requires various measures: regular insurances against fire, etc. insurances against diseases, crop insurances for natural disasters, additional sources of income against a diversification of risks etc. Among these solutions, professional diversification is the most important one for most enterprises, providing other advantages to farmers.

Concerning general risks—fire, disease, etc.—there are long existing solutions and the situation in agriculture is no different from other sectors of the economy. Among the financial tools, forward contracts prevail in individual farms. The use of international markets' sophisticated tools is limited to large enterprises and merchants—often collective enterprises belonging to farmers in Sweden.

Arguments in favour of government intervention in agricultural insurances are weak. The government's part must be limited to disasters, watching the market's competition level, and informing, appropriately and sufficiently, producer farmers on existing insurance tools. At the European Union level, it consists mostly of watching domestic systems maintain fair producing conditions among member states.

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[8] To date, ten.

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Agriculture, Agribusiness and Competition Policy

David Spector[1]

Two policies traditionally opposed

The common agricultural policy (CAP) and competition policy are indisputably the two most important European policies. One could add monetary policy although its sphere of application is limited to the Euro-zone. CAP is important because of its budget which is more than 40 % of the EU budget, i.e. about € 50 billions per annum. Competition policy is an important EU policy because it allows the EU to assert its power globally.

However, these two policies are based on seemingly contradictory principles. Competition policy is based on the idea that a free market is economically efficient. In contrast, the CAP is defended on the grounds of alleged market failures and the importance of not leaving such an important sector as agriculture to the vagaries of the market.

This contradiction was particularly striking before the 2003 CAP reform ("Fischler reform"). Several of the traditional CAP tools aimed at preventing prices from playing their "signaling" role of orienting economic agents' actions—to further changes in the economic environment.

Competition policy is justified on the grounds that a market in which prices are determined by free competition leads to both productive and allocative efficiencies. Productive efficiency occurs when the production of one good is achieved at the lowest cost possible. When goods are of various qualities, productive efficiency is equivalent to the optimum ratio between production costs and quality – this latter being measured by the price consumers are ready to pay. In a competitive market, competition aims to ensure prices close to the production costs of the most efficient producers, subjecting the others to losses or enticing them to leave the market or become more efficient. Thus, in theory, for given production costs, only producers offering maximum quality survive under vigorous competition. Reality is often more complex : consumers differ in their ability to pay for superior quality, and efficiency requires the coexistence of several types of producers, corresponding to several combinations of prices and quality.

Allocative efficiency means that goods are produced in quantities leading to maximization of the economic surplus, taking into account consumers' preferences and marginal costs of production. In a market economy, allocative efficiency requires prices paid by consumers to be proportional to the marginal costs of production of given goods. Usually, a competitive economy reaches this goal when each product's price is equal to its marginal cost of production.

Now, several aspects of the common agricultural policy aim explicitly at hindering the operation of pricing mechanisms which, in a competitive market, would lead closer to productive and allocative efficiency.

The best example of this is the milk quota. Established in 1984 and designed to last until 2015, the milk quota allocates to each country a quota of production which is then shared among the country's farms. In France, the allocation helps to maintain milk production in mountainous areas where costs are higher. So, by definition, milk quotas aim at forbidding production concentration in countries and on farms where the costs would be the cheapest, that is, preventing a fundamental market phenomenon from operating as it does in other sectors of the economy.

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Production subsidies (abolished for cereals since the Fischler reform, but largely maintained for breeding, especially in some countries like Spain and France), tend to alter some products' relative prices and thereby prevent the competitive pricing mechanism from achieving allocative efficiency. Indeed, subsidizing meat production without subsidizing the production of cereals effectively encourages the use of cereals for animal feed rather than human consumption. This distortion results in higher meat consumption than would otherwise be the case. If prices were established by the free market, with no public intervention, the recent rise of the price of cereals on the global market would have led farmers to increase the production of food cereals and decrease meat production. This would have reduced the profits of breeders' and raised those of cereal producers, thereby putting downward pressure on global cereal prices.

In terms of consumption, the decrease in meat production would have lead to an increase in the price of meat and a consequent decline in consumption. But such a series of events, matching the allocative efficiency, is hindered by CAP subsidies. Indeed, CAP encourages producers and consumers to adapt their decisions to the relative scarcity of products rather than to their price.

The market distortions induced by CAP prior to the 2003 reform cost around 0.9% of GDP, a high figure given the rather modest share of agriculture in the economy (around 2% of the GDP).[2]

Possible convergences between agricultural policy and competition policy

For the last few years, differences between agricultural and competition policies have tended to lessen.

The changes in agricultural policy following the Fischler reform, enforced as of 2005, represent a significant step towards the abolition of price signal distortions. This reform, together with previous ones, replaces production subsidies with a "decoupled single payment" under which the payment is linked to the prior year's subsidy, not to production. In terms of distributive justice, this mechanism may be questionable. It allows, for example, cereal producers to benefit concurrently from significant government aid and very high prices on global markets in 2008.

The other limitation of the Fischler reform is its partial nature. Members of the European Union were allowed to maintain some coupling – up to 25% of arable crops aids, 100% for suckler cows and 50% for ovine and caprine premiums. Significantly, France chose to limit as much as possible the impact of this reform : it chose to delay implementation until 2006 (countries could choose between 2005 or 2006), and to use the maximum allowed "coupling" possibilities. Nevertheless, the Fischler reform shows a reorientation of the agricultural policy towards market logics.

As for competition policy, evolution is no less significant. Let's start by remembering that, contrary to what is commonly thought, the agricultural sector is in fact subject to the competition policy.[3] Indeed, regulation 26/62 (adopted in 1962 and replaced by regulation 1184/2006 which does not amend it significantly) states that *« Article 81(1) of the Treaty [on agreements] shall not apply to such of the agreements, decisions and practice referred to in Article 1 of this Regulation as form an integral part of a national market organisation or are necessary for attainment of the objectives [of the*

[3] B. Borrell and L. Hubbard, « Global economic effects of the EU Common Agricultural Policy », *Economic Affairs*, vol. 20(2), 2000.

[4] For further details on competition law in the agricultural sector, please refer to Michel Debroux' article : « Les raisons d'une cohabitation orageuse », Concurrences 4-2008.

Common Agricultural Policy] […] which concern the production or sale of agricultural products or the use of joint facilities for the storage, treatment or processing of agricultural products, and under which there is no obligation to charge identical prices, unless the Commission finds that competition is thereby excluded […] »

As a consequence, even if the agricultural sector benefits from specific provisions, these latter must nevertheless be subjected to competition policy.

Moreover, competition authorities frequently use their authority to limit sectoral dispositions which hamper competition. Thus, in the decision related to the "French beef" case, the Commission prohibited the French government from setting a minimum purchase price for breeders' customers.

Although the competition authority continues to watch out for restrictions on competition which harm consumers, competition policy is evolving in a way which should allow it to take into account the specific needs of the agricultural sector. The competition authority increasingly undertakes a case-by-case economic analysis and allows some restraints on competition if they compensate for obvious market failures in a manner which advances consumer interest.

Before describing specific cases, let us come back to the general idea of competition policy. It has two significant differences from general economic policy. First, its main goal is to promote consumer surplus—a different notion from global surplus which takes into account both consumers and producers. "Ensuring a fair living standard for farmers", which is one of CAP's objectives, consists of paying special attention to producers, and thus differs from the objective of competition policy—except if we consider that non-distorted competitive prices are, by definition, "fair."

The other main characteristic of competition policy lies in the high evidentiary standards. Based on the fact that competition policy relates to the rule of law, differentiating it from general economic policy may be based on rather uncertain appraisals.

Consequently, the traditional arguments used in favour of the annual 50 milliard Euro support for the agricultural sector, whatever the circumstances, can hardly be taken seriously by competition authorities when ruling on disputes related to competition.

For example, security of supply and hygiene are irrelevant to the protection of consumers from unfair competition. Moreover, some aspects of the Common Agricultural Policy (like milk quotas) lead towards production restrictions and therefore contradict this objective.

Similarly, irrelevant in cases involving competition policy are arguments based on the positive externalities created by agricultural activities such as the existence and prosperity of the wider Agribusiness sector, or the protection of the countryside, ecology, and economic life in rural areas. Moreover, these arguments are not supported by a rigorous analysis and are unlikely to sway competition authorities. Finally, the Common Agricultural Policy is sometimes justified by strictly distributive objectives. Nevertheless, it is hard to understand why it would be legitimate to help individuals according to their profession, rather than their income, especially given that farmers do not constitute an underprivileged job category. Moreover, CAP subsidies' major effect is to augment land prices not to increase farm income.

On the other hand, in cases dealing with professional organisations, competition authorities have acknowledged the legitimacy of limited restrictions on competition designed to address

market failures provided the restrictions do not harm consumers.

Opinion 08-A-07 of May 7, 2008, on the Organisation of fruit and vegetable processing industry, released by the Competition Council, constitutes one of the clearest examples of this flexibility. The Council stated that it has nothing against competitors sharing detailed information nor their jointly negotiating with distributors. A detailed economic analysis showed that these practices, usually forbidden, could foster productivity and would not harm consumers. Sharing information allows producers to better anticipate future prices and therefore reduce uncertainty when planting their crops. Both the economic theory and the empirical analysis show that reducing the uncertainty tends to foster investment, which favours competition. In as much as producers use information-sharing to improve transparency and not to increase prices the Council ruled that the positive effects out weighted the negative ones.

The question of joint negotiations with distributors is more complex. Indeed, from a competition policy point of view, redistributing a share of the value created by distributors to producers is not a valid objective. On the other hand, distributors' purchasing power is often considered a benefit to consumers. However, in some cases, distributors may use their power to lower wholesale prices to a point that producers lose their will to produce and improve their products' quality—knowing that their efforts will mainly benefit distributors.

Joint negotiations do not necessarily benefit consumers because they can lead to scarcity and higher retail prices. The Council therefore considered that the imbalance between producers and distributors was such that it needed a joint negotiation, for consumers' sake.

Despite the imbalance between producers and distributors, the Council opposed the joint-setting of minimum prices, in accordance with all its judicial precedents, and the creation of dominant supply side positions.

Nowadays, competition authorities tend to favour balance. Suppressing definitively the tension between the founding principles of competition policy and those of the Common Agricultural Policy is illusive. However, convergence is certainly possible.

To conclude, we must stress that competition policy sometimes directly benefits agricultural interests, as when it both controls concentration in the distribution sector, and, curbs abusive practices or cartels of firms providing inputs to the agricultural sector.

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